# Capnocheck® Plus

## Service Manual

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**Catalog Number 1873**
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# Chapter 1: Introduction

## Warranty & Service Information

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Repairs of BCI International's devices under warranty must be made at authorized repair centers. If the device needs repair, contact BCI International's service department or your local distributor to request a customer service report number (CSR). When calling, have the device's model and serial number ready.

**NOTE:** Shipments received without a CSR number will be returned to sender.

If you need to ship the device, pack the device and its accessories carefully to prevent shipping damage. All accessories should accompany the device.

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## About This Manual

This manual contains circuit descriptions, voltage and waveform test points, detailed parts lists, and circuit diagrams for the capnometer. It is intended for persons trained in service, maintenance, and repair of modern medical equipment. Thorough knowledge of this equipment's operation is required before attempting to repair this equipment.

## ⚠ Warnings, Cautions, and Notes

| KEYWORD | DEFINITION |
|---|---|
| WARNING | Tells you about something that could hurt the patient or hurt the operator. |
| CAUTION | Tells you about something that could damage the monitor. |
| NOTE | Tells you other important information. |

### Warnings

**WARNING:** Federal law (USA) restricts the use or sale of this device by, or on the order of, a physician.

**WARNING:** Do not use this device in the presence of flammable anesthetics.

**WARNING:** Do not autoclave, ethylene oxide sterilize, or immerse in liquid. Unplug before cleaning or disinfecting.

**WARNING:** ELECTRICAL SHOCK HAZARD when cover is removed. Do not remove covers. Refer servicing to qualified personnel.

**WARNING:** Use only $SpO_2$ probes supplied with, or specifically intended for use with, this device.

**WARNING:** Do not use this device in the presence of magnetic resonance imaging (MR or MRI) equipment.

**WARNING:** Do not plug the monitor into an outlet controlled by a wall switch.

**WARNING:** This device must be used in conjunction with clinical signs and symptoms. This device is only intended to be an adjunct in patient assessment.

**WARNING:** In the event that earth ground integrity is lost, the performance of this device and/or other devices nearby may be affected due to excessive RF emissions.

**WARNING:** Reposition the $SpO_2$ probe at least once every four (4) hours or as needed to allow the patient's skin to respire.

**WARNING:** When attaching $SpO_2$ probes with Microfoam® [1] tape, do not stretch the tape or attach the tape too tightly. Tape applied too tightly may cause inaccurate readings and blisters on the patient's skin (lack of skin respiration, not heat, causes the blisters).

**WARNING:** The displayed message $FiO_2$ Ref Err indicates a factory calibration setting is incorrect. Contact your authorized repair center.

**WARNING:** Each $FiO_2$ cell has different output characteristics; changing the $FiO_2$ cell without calibrating the monitor can result in incorrect displayed $FiO_2$ values. The incorrect values are unpredictable in both magnitude and direction, possibly resulting in hypoxic $FiO_2$ gas mixtures while displaying high $FiO_2$ values. It is your responsibility to properly calibrate the monitor after changing $FiO_2$ cells.

**WARNING:** When connecting this monitor to any instrument, verify proper operation before clinical use. Refer to the instrument's user manual for full instructions. Accessory equipment connected to the monitor's data interface must be certified according to the respective IEC standards, i.e., IEC 950 for data-processing equipment or IEC 601-1 for electromedical equipment. All

[1] Microfoam® is a registered trademark of the 3M Company.

combinations of equipment must be in compliance with IEC 601-1-1 systems requirements. Anyone connecting additional equipment to the signal input port or signal output port configures a medical system, and, therefore, is responsible that the system complies with the requirements of the system standard IEC 601-1-1.

## Cautions

**CAUTION:** Ensure the device's AC rating is correct for the AC voltage at your installation site before using the monitor. The monitor's AC rating is shown on the external power supply. If the rating is not correct, do not use the monitor; contact BCI International's service department for help.

**CAUTION:** This device is intended for use by persons trained in professional health care. The operator must be thoroughly familiar with the information in this manual before using the monitor.

**CAUTION:** Do not allow water or any other liquid to spill onto the monitor. Unplug the external power supply from the monitor before cleaning or disinfecting the monitor.

**CAUTION:** Pressing front panel keys with sharp or pointed instruments may permanently damage the keypad. Press front panel keys only with your finger.

**CAUTION:** Do not disassemble unit, not user serviceable. Refer to qualified service personnel.

## Notes

**NOTE:** Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and fluorescein, may cause an inability to determine accurate $SpO_2$ readings.

**NOTE:** Any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and $SpO_2$ readings.

**NOTE:** Operation of this device may be adversely affected in the presence of strong EM or RF sources, such as electrosurgery equipment.

**NOTE:** Operation of this device may be adversely affected in the presence of computed tomograph (CT) equipment.

**NOTE:** Significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin, will affect the accuracy of the $SpO_2$ measurement.

**NOTE:** $SpO_2$ measurements may be adversely affected in the presence of high ambient light. If necessary, shield the probe area (with a surgical towel, for example).

**NOTE:** Remove fingernail polish or false fingernails before applying $SpO_2$ probes. Fingernail polish or false fingernails may cause inaccurate $SpO_2$ readings.

**NOTE:** Store the $FiO_2$ cell as shipped in its protective wrapping, until it is ready to use. This maximizes the $FiO_2$ cell's shelf life.

**NOTE:** Prolong $FiO_2$ cell life by avoiding high $O_2$ and $CO_2$ concentrations when it is not in use.

**NOTE:** $FiO_2$ Humidity and Pressure Compensation:

Humidity (i.e. water vapor) is not an interferent, and does not affect the $FiO_2$ cell accuracy. Water vapor behaves as any diluting gas and reduces the oxygen partial pressure; the $FiO_2$ cell will correctly indicate the reduced percent $FiO_2$. However when calibrating the $FiO_2$ cell, the humidity of the calibration gas reduces the oxygen partial pressure, it is for this reason that calibration gas must be dry. For example, at 37°C, water vapor pressure (PH2O) is 47 mmHg, reducing the oxygen partial pressure of 100% oxygen to (760-47) 713 mmHg and results in an oxygen concentration of 94%. If the sensor must be calibrated with humidified oxygen, then if the calibration gas is 100% humidified, the following equation provides a correction factor that must be applied to all $FiO_2$ readings:

$$C_{H2O} = \frac{P_{cal} - P_{H2O}}{P_{cal}} \qquad (1)$$

In addition, if the pressure of the calibrating gas (Pcal) is not 760 mmHg, then a further correction can be made according to the following:

$$C_{cal} = \frac{P_{cal}}{760\ mmHg} \qquad (2)$$

The $FiO_2$ cell manufacturer specifies an operating pressure (Psys) range of +/- 200 mmHg (+/- 4 psig). The $FiO_2$ cell response is proportional to oxygen partial pressure, the result being that indicated $FiO_2$ can be corrected for the difference in pressure between the operating system and the calibrating system pressure. The correction can be obtained from the following equation:

$$C_{sys} = \frac{760\ mmHg}{P_{sys}} \qquad (3)$$

The final result is that actual $FiO_2$ can be calculated from indicated $FiO_2$ by combining equations 1, 2 and 3:

$$FiO_2\ (actual) = FiO_2\ (indicated) * C_{H2O} * C_{cal} * C_{sys} \qquad (4)$$

# Pneumatics Cleaning

Cleaning of the pneumatics system is only recommended if done by qualified service technicians. Cleaning of the pneumatics is generally not required if proper filter is used at all times. However, improper use of the device or use under very harsh conditions may warrant periodic cleaning.

### The Pneumatics consists of five main parts:

- Tubing
- Sample cell (i.e. $CO_2$ bench)
- Diaphragm pump
- Three-way autozero valve
- Pressure transducer

Each of the above parts should be cleaned independent of each other. For example, all tubing should be disconnected from components before cleaning. Use one of the following procedures, whichever is most appropriate:

### Procedure:

For tubing and diaphragm pump:

1. Pass a mild detergent through to remove any oily residue or contaminants.
2. Flush with distilled water to remove the detergent.
3. Flush with absolute ethanol to remove the moisture.
4. Flush with dry gas to evaporate ethanol and dry the component thoroughly.
5. Make sure components are dry before reassembling.

Three-way autozero valve:

1. Flush with dry gas. Do not flush with alcohol or water.

Pressure transducer and $CO_2$ bench:

1. If contaminated it must be replaced by a qualified service technician.

After the device is reassembled, make sure to check for proper operation and flow rate. If the device does not function as specified refer to qualified service technicians for repair or replacement of pneumatics components.

# Chapter 2: Field Service Menu

Some factory service menu options can also be set through the Field Service menu on the monitor. To access the field service menu, power up the unit and listen for the beep. After the beep, use two hands to momentarily press the **WAVE/TREND** and **MENU/ENTER** keys at the same time. When the power up screen goes away, press **MENU/ENTER** to display the main menu. Press **MENU/ENTER** again to select "SERVICE", which is the first item in this menu.

## Field Service Menu

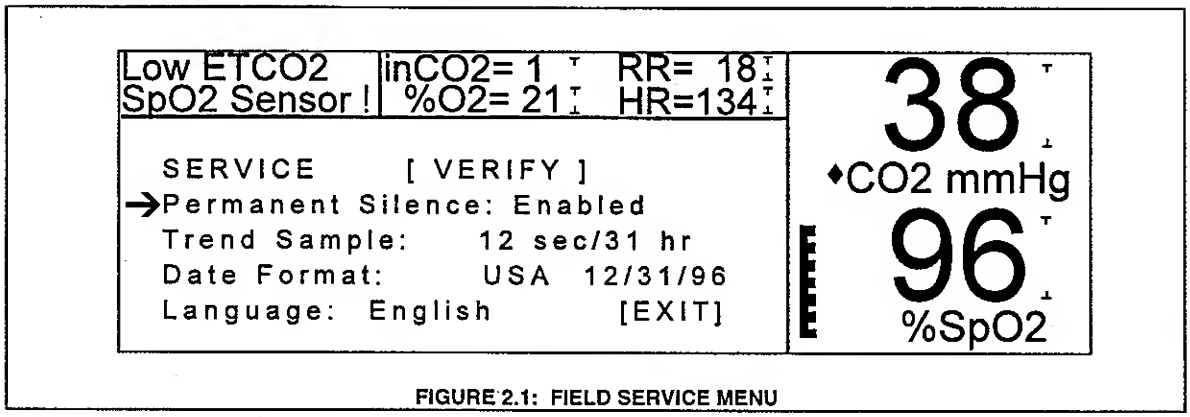



FIGURE 2.1: FIELD SERVICE MENU

**VERIFY** — This takes you to another menu which shows internal capnograph parameters.

**Permanent Silence** — "Enabled" means alarms can be silenced indefinitely by pressing and holding the **ALARM SILENCE** key for 3 seconds. "Disabled" means indefinite alarm silence is not allowed. In this case, only 2-minute alarm silence is available.

**Trend Sample** — This selects the basic sample time for trend data record storage. The sample time determines the maximum number of records stored and consequently the maximum storage time. "12 sec/31 hrs" means 12 second sample time for 31 hours maximum storage. "4 sec/10 hrs" means 4 second sample time for 10 hours maximum storage.

**NOTE: If the Trend Sample time is changed, the monitor will turn off after quitting the Service menu. This forces the monitor to reconfigure memory at power up.**

**Date Format** "USA" selects a date format of month/day/year. "EURO" selects a European date: day/month/year.

**Language** Selects the language for all displayed text: English, French, German, Spanish, or Italian.

**NOTE: When the language is changed, you will not see the display in that language until after you exit the Service menu. The monitor will power down and the new language is loaded at power up.**

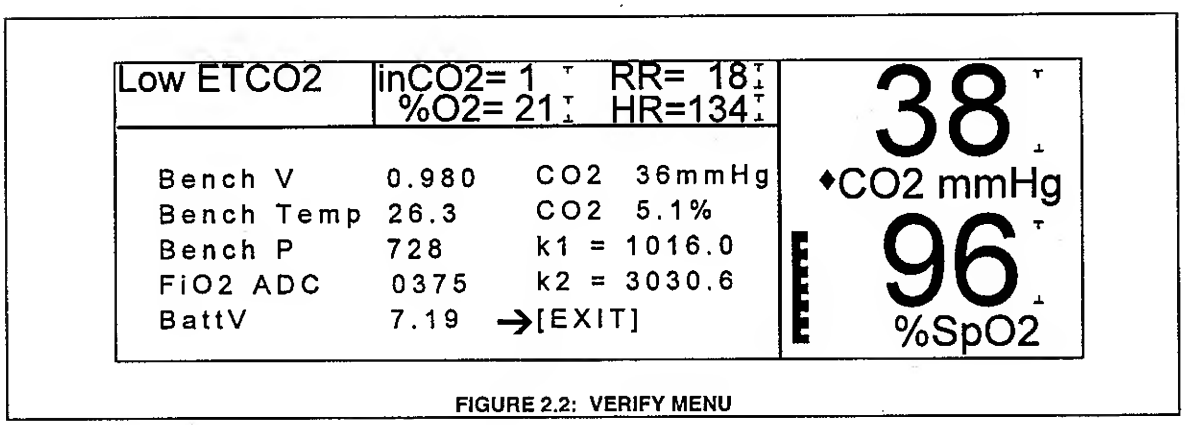



FIGURE 2.2: VERIFY MENU

**Bench V** The voltage on the output of the $CO_2$ sensor is proportional to the $CO_2$ concentration. During troubleshooting this value can be used to verify whether the sensor is operational. If a different amount of $CO_2$ is passed through the system, the "Bench V" value will vary: the higher the $CO_2$ value, the lower the "Bench V." Note: All benches are slightly different. Factory calibration compensates for the difference. Use "Bench V" as a relative number only.

**Bench Temp** The temperature of the $CO_2$ sensor, in °C, which is used by the algorithm to compensate for temperature dependency of the sensor. Because of the heating element inside the bench, expect the "Bench Temp" to be a few degrees higher than ambient temperature.

**Bench P** The pressure inside the bench chamber (in mmHg). It is measured by an external (from $CO_2$ bench) pressure sensor. When the pump is running, anticipate this value to be below the ambient pressure.

| | |
|---|---|
| **$FiO_2$ ADC** | The $FiO_2$ Analog-to-Digital converter reading in counts. When the $FiO_2$ sensor is not plugged in, this reading must be close to zero. If the $FiO_2$ sensor is replaced with a short, this value is around 350 counts. If the $FiO_2$ sensor is plugged in, this value will increase with an increase in $O_2$ concentration. |
| **Batt V** | The voltage on the battery terminals as seen by the system Analog-to-Digital converter. If the battery is charging, this voltage will increase to more than 7 V. If the unit is running on the battery, this voltage will slowly drop from 6 to 5 V. |
| **$CO_2$ mmHg** | Current $CO_2$ reading in mmHg. |
| **$CO_2$ %** | Current $CO_2$ reading in percent. For example, if 10% $CO_2$ gas is supplied, expect to see a value in the range of 9.6% to 10.4%. |
| **k1, k2** | Calibration constants. These numbers reflect the $CO_2$ curve: $CO_2$ concentration vs. $CO_2$ sensor voltage. If a low/high cal has been done, expect to see slightly different k1 and k2 values. |

# Chapter 3: Capnocheck® Plus Circuit Description

## Battery Charger

The battery Charger is built around charging controller U17. This IC controls the charging current in both fast charge and trickle charge modes, switching from fast charge mode to trickle charge mode when the end of charge condition has been reached. It senses charging current by measuring the voltage drop across current sense resistor R63. Thermistors T3, T4 and the thermistor inside battery pack in combination with resistors R59..R61 provide temperature control, preventing fast charge in very cold or very hot environments, and, also, preventing battery from overheating during fast charge. U17 controls the switch mode voltage regulator U18 using current mirror Q8-Q9. This completes the feedback loop.

The charging indicator circuitry is built around multivibrator Q12-Q13. Depending on the FAST control signal (U17, pin 8), the green LED either stays lit (in trickle charge mode) or blinks with a very low duty factor (in the fast charge mode).

## System Power Supply and ON/OFF Circuitry.

The system +5VDC power supply is built around a low drop voltage regulator IC U20. MOSFET transistor Q11 is used as a controlled element. Isolated power for the Oximeter Slave Board is generated by the DC-DC voltage converter built around U21, Q14 and transformer T5. The clock signal for the converter is the microprocessor clock divided by the frequency divider inside U4.

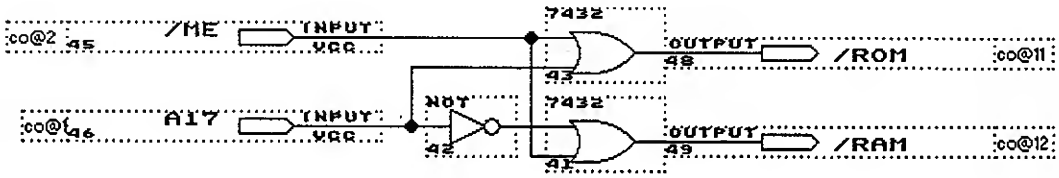
The Power ON/OFF circuitry is built using the voltage comparator located inside the "watch dog timer" IC U19. When the STNBY/ON key is pressed, it pulls the base of PNP transistor Q10 to "ground" through resistor R67. Transistor Q10 pulls up EN (enable) input of voltage regulator U20 turning system +5V on. From then the high voltage level on EN input is maintained by the VCC voltage through resistors R68 and R69 until power is off.

There are several conditions which can power down the Monitor. If the STNBY/ON key is pressed, the microprocessor generates a /HALT signal which pulls down the PFI input of the voltage comparator inside U19. The output open drain signal, /PFO, goes low and turns off U20 by pulling EN low. The other condition for turning the Monitor off is a low battery. The battery voltage is measured by the resistor divider R65-R65. If this voltage is lower than the 1.25VDC threshold of the internal comparator U19, the output signal, /PFO, goes low.

In addition, the output of the resistor divider is connected to the Analog-to-Digital converter, and is read by the microprocessor to give an early warning about low battery condition.

## Microprocessor Section and Address Decoders

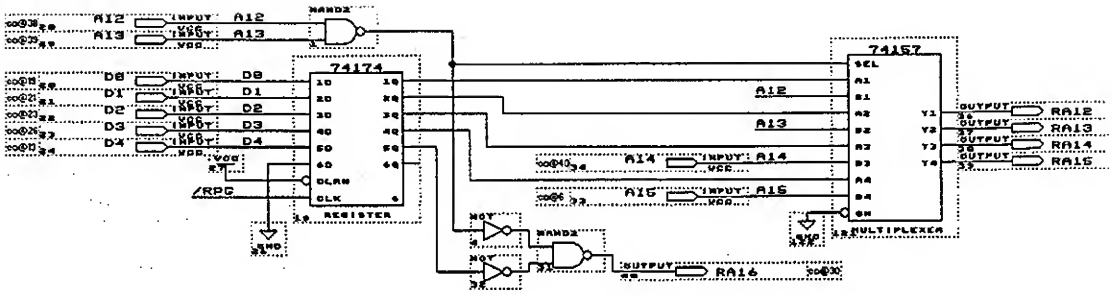
Microprocessor U1 is a Zilog Z180. Its address and data buses are connected to the One Time Programmable Read Only Memory (OTP ROM) U2 and Random Access Memory (RAM) U3. A Memory Address Decoder is implemented in the Field Programmable Gate Array (FPGA) U4. The following drawing shows the Memory Address Decoder section of FPGA:




The memory address map is shown in the following table:

| Device | Address Space |
|---|---|
| OTP ROM | 0 .. 1FFFF |
| RAM | 20000 .. 23FFF |

FPGA U4 also includes a RAM Page Selector used to split the whole RAM area into pages, which can be accessed by the microprocessor. The corresponding section of FPGA is shown on the following drawing:

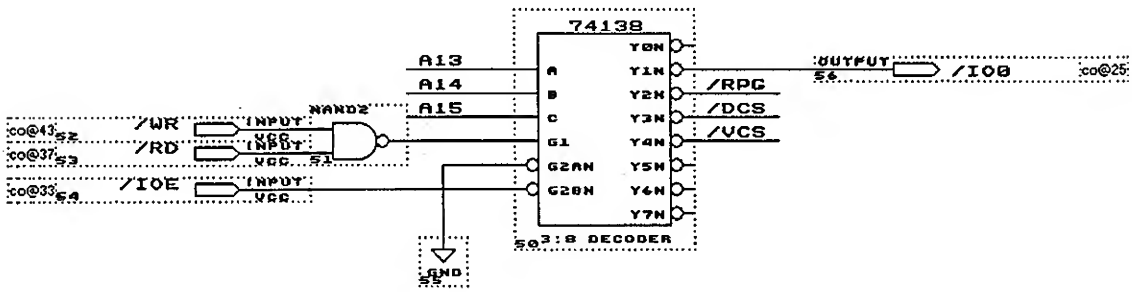



The Page Selector includes a Page Register - a five bit output port, in which the microprocessor stores the page number. Hence, a total of 32 pages exists. The total RAM size is 128 kbytes, each page is 4 kbytes long. The Page Selector is configured such that the first three pages can exist as "solid" 12 kbytes of memory, which allows a large amount of data to be located in continuous memory.

| RAM Address Space | RAM Page |
|---|---|
| 20000 .. 20FFF | Page 0 |
| 21000 .. 21FFF | Page1 |
| 22000 .. 22FFF | Page 2 |
| 23000 .. 23FFF | Pages 0..31 |

By writing a page number into the Page Register, address space 23000 .. 23FFF can be assigned to any of 32 pages. As seen from the table, RAM pages 0, 1 and 2 can be either part of 12kbytes of continuous address space, or can be selected together with other pages to reside in the top 4kbytes (address 23000 .. 23FFF). For practical reasons, they are always accessed as continuous memory.

The address decoder for the Input / Output Interface devices is implemented in FPGA U4. The corresponding section of FPGA is shown on the following drawing:



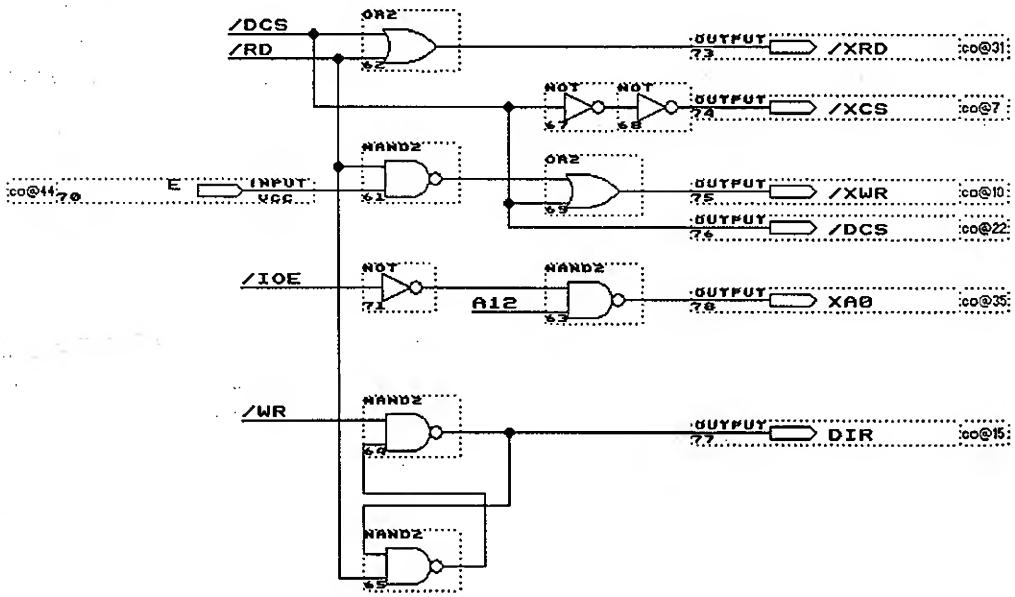
The I/O address space is divided according to the following table:

| I/O Address Space | Device |
|---|---|
| 0 .. 1FFF | Used by Z180 for internal registers |
| 2000 .. 3FFF | External I/O |
| 4000 .. 5FFF | RAM Page Register |
| 6000 .. 7FFF | Display Select |
| 8000 .. 9FFF | Volume Control Select |
| A000 .. FFFF | Not used |

External I/O is the only I/O select available outside the FPGA, all others are used inside the chip.

## Display Controller.

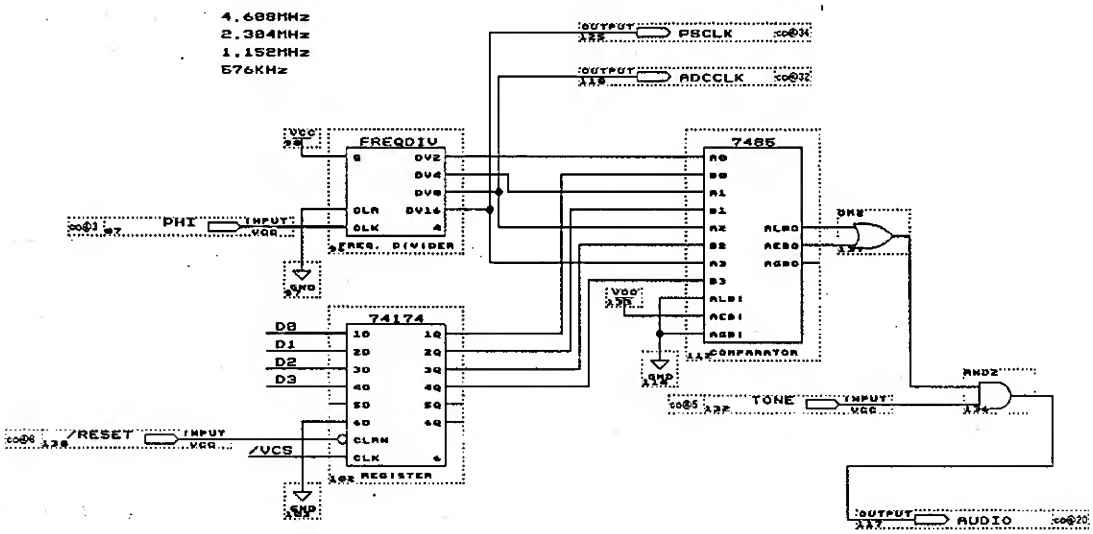
Vacuum Fluorescent Display Module is used in the Monitor to display graphical and numerical information. The Display has its own controller board which accepts data in parallel 8-bit format in the form of Commands (signal A0 on the Display communication connector J2 is log. 1) and Data (signal A0 on the Display communication connector J2 is log. 0). Bi-directional data bus buffer U5 is used to pass data from the Display board to the microprocessor and from the microprocessor to the Display Board. All signals to control U5 and Display Board are generated inside FPGA U4:



The timing diagrams of the Display Write and Read Cycles are shown on the schematic. From the microprocessor's "point of view", the Display Board represents a general purpose I/O device, controlled using signals /CS - select, /WR - write, /RD - read and A0 - Command/Data select. Signals /DCS and DIR control the bi-directional buffer and prevent any possible bus conflicts between Display Board, buffer and microprocessor.

## Speaker Volume Controller.

Speaker Volume Controller is located in FPGA U4. The corresponding fragment of FPGA is shown on the following drawing:




The volume control code is stored by the microprocessor into a four bit parallel register. Code 0 corresponds to the lowest volume, code F - to the highest. Volume control circuitry inside FPGA also includes a binary counter which divides the microprocessor clock frequency. The by-products of this counter are the clock frequency for the Analog - to - Digital Converter (signal ADCCLK) and for the DC-DC converter (signal PSCLK). The binary code from the divider is compared with the number stored in the four bit parallel register. The result of the comparison is the pulse train with a variable duty cycle which depends on the number stored in the parallel register. If the number equals zero, the duty factor is 1/16, if the number equals F, the duty factor is 1, or the output represents constant logical "one". Then the signal is gated with the TONE signal - audio frequency signal generated by the microprocessor. The external R-C filter converts the resulting pulse train into an audio frequency signal, the amplitude of which is directly proportional to the number stored in the parallel register. Hence, a total of 16 levels of volume, plus OFF, can be achieved with this circuitry.

## External I/O's

External I/O's include an 8 bit input buffer and a 14 bit output register. The input buffer allows the microprocessor to read keyboard signals and serial data streams coming from the Real Time Clock (RTC) IC, Analog - to - Digital Converter (ADC) and CO2 Bench internal Electrically Erasable Programmable Read Only Memory (EEPROM). The output register allows the microprocessor to control LED's, keyboard strobe signals and all other peripheral devices.

## Pump and Valve Control.

The pump and valve are controlled by the microprocessor through External I/O output register. Dual MOSFET Q4 is used to turn pump and valve on and off.

## Speaker Driver.

The Speaker Driver is built around operational amplifier U12A. It controls the speaker driving transistor Q5. The input signal AUDIO generated by FPGA is filtered by passive R-C filter R25-C19-R26 to restore the DC component of the AUDIO signal, which is then amplified by U12A and Q5 circuitry and is passed to the speaker through connector J6.

## Analog Outputs Controller.

The Analog Outputs Controller is built around Digital - to - Analog converter (DAC) U9. IC U9 contains three independent 8-bit (256 voltage steps) DAC's inside, which are used for analog output channels A, B and C. U13A, with associated resistors, converts the 2.5VDC voltage reference output into a 1VDC output used as a reference signal for analog outputs. The output of the first internal DAC (signal OUTA) is connected through an ESD protection network R33-C27 to the output DB25 connector. The outputs of two other internal DAC's are not internally buffered like the output of the first internal DAC. That is why two voltage followers U12B and U12C are used as buffers between DAC and output connector. The DAC is controlled by the microprocessor using synchronous serial communications.

## RS232 Controller.

The RS232 Controller is built around IC U10, which is used to convert CMOS voltage levels into RS232 bipolar voltage levels. U10 is connected directly to the output DB25 connector through ferrite beads.

## Real Time Clock.

The Real Time Clock U11 is a system "watch". It is powered from either the main +5VDC or the Lithium Battery BT1 when the Monitor is turned off. Switching between main and battery power is performed by the watch dog timer U19. Crystal X2 is directly connected to U11 to provide a very accurate time reference. The Real Time Clock IC can be set and read by the microprocessor through serial communications. The data line coming to U11 is by-directional, and is used for both data in and out. Transistor Q6 and resistor R36 convert two separate input and output serial data signals into one bi-directional data signal using open collector with passive pull up approach. Diode D11 is used for ESD protection.

## Watch Dog Timer

Watch Dog Timer IC U19 is used to perform the following three functions:

- Its internal comparator is used in the ON/OFF circuitry (see earlier);
- It switches V-RAM from the main +5VDC power to 3VDC Lithium Battery BT1, providing power for both RAM and the Real Time Clock;
- It resets the microprocessor at power up;
- It resets the microprocessor if signal WDI is not generated for a long time, which indicates that microprocessor was upset by ESD discharge and is not running properly.

## Analog Section

The analog section is used to acquire data from sensors and read battery voltage. Analog - to - Digital Converter (ADC) U14 can convert up to eight input voltages in the range of 0 to VREF. Signal VREF is generated by the voltage reference U16 and equals 2.50VDC. ADC communicates to the microprocessor serially.

### $CO_2$ Sensor

The $CO_2$ Sensor (or $CO_2$ Bench) generates two output voltages. One indicates $CO_2$ concentration, and the other is proportional to the $CO_2$ detector's temperature. The light source inside the Bench is precisely controlled by the current sink circuitry built around U15B and the 0.1% accurate resistor, R45. The voltage across R45 is maintained equal to VREF, hence the current through resistor is very stable and accurate.

The voltage level from the Bench, which indicates $CO_2$ concentration, comes to the gain-offset stage built around U15A and R48. It converts the Bench voltage level into an ADC compatible voltage range. The gain - offset equation is:

$$Vout = 2.77 * Vin - 1.646V$$

Another function of U15A in combination with R82, R81, C89 and C88 is to create a low pass filter to reduce out-of-range noise.

A voltage level proportional to the $CO_2$ detector's temperature comes directly to the input of ADC. It does not require any amplification or level shifting.

### Pressure Sensor.

The Pressure Sensor is used in the Monitor to measure Bench pressure and ambient pressure when the pump is turned off. An integrated temperature compensated pressure sensor MP1 is used. Its output voltage level is directly proportional to the absolute pressure. To convert its output voltage into 0..2.5VDC ADC input range, precise divider R48 is used.

### $FiO_2$ Sensor.

The $FiO_2$ sensor represents a millivolt range voltage source. U13B with associated components is used to amplify the millivolt range sensor output voltage into a 0..2.5VDC ADC input range. If the sensor is not plugged in, the input of the operational amplifier U13B is at "ground" level, which indicates "no sensor" condition. If the sensor is plugged in, the offset voltage from the resistor divider R87-R88 shifts the input voltage high, indicating "sensor" condition. The offset value is acquired and stored during the factory calibration process.

### Battery Voltage Level.

The battery voltage comes to the analog section through resistor R50 and is buffered by U12D. Then it is directly digitized by the ADC. This information is used by the microprocessor to generate an early low battery warning.

# Signal Dictionary

This section lists, in alphabetical order, the signal names used on the schematics. The signal's origin, destination, and purpose are described.

## Main Board

| SIGNAL | DESCRIPTION |
|---|---|
| A0-A17 | A0 through A17 are the microprocessor's address lines. A0-A17 are used to address the RAM, PROM, and I/O ports. |
| A18 = TONE | Microprocessor output A18 (TOUT) is configured as a timer output and controls the tone of the optional pulse beep speaker. |
| ACH0-ACH2 | Three analog output signals. |
| ADCCLK | ADC clock frequency of 1.152MHZ. |
| /ADCS | Signal used to select ADC. |
| ADDI | Synchronous communication input data line, same as DI |
| ADDO | Synchronous communication ADC output data line |
| ANA+5 | The +5 volt power supply VCC is filtered to produce ANA+5. ANA+5 powers the analog circuitry. |
| AUDIO | Pulse-width-modulated signal representing audio TONE frequency used to control speaker driver and generated by U4. |
| BATT | Signal used to monitor battery voltage, equals to VBATT in magnitude. |
| BTEMP | CO2 bench output voltage proportional to the bench temperature. |
| /BUSY | Return signal from the external printer or computer. Indicates that remote device is not ready to receive data from the Monitor. Is converted to CTS0 signal by U10. |
| /CAL | Signal which initializes ADC self-calibration cycle. |
| CKS | CKS is the microprocessor's high-speed, synchronous serial output clock signal. |
| /CONVST | Signal which initializes ADC conversion cycle. |
| CO2 | Voltage generated by the gain-offset stage U15A indicating CO2 concentration. |
| /DACS | Signal used to select DAC chip U9. |
| D0-D7 | D0 through D7 are the microprocessor's data lines. The data lines are routed to RAM, PROM and peripheral devices. |
| DI | Synchronous communication input data line, same as ADDI |
| DO | Synchronous communication output data line |
| DIR, /DCS | Signals used to control bi-directional display communication buffer U5. |
| EECLK | CO2 bench internal EEPROM clock signal. |
| /EECS | Signal to select CO2 bench internal EEPROM chip. |
| FAST | Log. 0 indicates fast battery charging mode. |

| SIGNAL | DESCRIPTION |
|---|---|
| FIO2 | Voltage proportional to FiO2 concentration. |
| /HALT | Signal used by microprocessor to turn power off. |
| /IO0 | Strobe to U6 to read input data and to U7 and U8 to latch output data. |
| ON-STBY | Line connected to the O/I key. |
| PFI, /PFO | Power fail input and output signals, used to shut down the monitor if battery is too low. |
| PWR-LED | Used to light green "CHARGE" LED on the keypad. |
| PSCLK | Clock frequency 576KHZ used for Isolated Power Supply |
| PHI | Clock signal generated by microprocessor. |
| PRESS | Voltage proportional to the CO2 cell absolute pressure. Equals to the output of the pressure sensor divided by two. |
| PUMP | Signal to turn pump on and off. |
| /RD, /WR, /ME, E /IOE | Signals used by microprocessor to control memory and peripheral devices. |
| /RESET | Microprocessor and peripheral devices reset signal. |
| /RAM | Signal used to enable RAM |
| RA12-RA16 | Address lines to select RAM page. |
| /ROM | Signal used to enables ROM |
| /RTCS | Signal used to select Real Time Clock chip. |
| RXS | RXS is the microprocessor's high-speed, synchronous serial input receiving data signal. |
| STBY | Input signal indicating that I/O key was pressed. |
| SCLK | Synchronous communication clock line. |
| TX0, RX0, CTS0 | Asynchronous serial communication signals used to control external optional printer. |
| TX1, RX1 | Asynchronous serial communication signals used to communicate with Little Oximeter Board. |
| TXS | TXS is the microprocessor's high-speed, synchronous serial output transmitted data signal. |
| VALVE | Signal to turn valve on and off. |
| VBATT | Signal used to monitor battery voltage. |
| +VBATT, -VBATT | Positive and negative battery wires. |
| VCO2 | CO2 bench output voltage, indicates CO2 concentration. |
| VLED | Unregulated power from external Charger. |
| +VP | Unregulated power either from battery of from external Charger. |
| V-RAM | +5 VDC voltage when unit is on, or +3VDC voltage if unit is off. Used to continuously power RAM and Real Time Clock. |
| VREF, 2.500V | 2.500 VDC reference voltage. |

| SIGNAL | DESCRIPTION |
|---|---|
| VCC | VCC is the regulated +5 VDC supply generated by +5 volt power supply regulator chip U20 and its discrete components. |
| VDD | Same as VCC. |
| VSS | Digital ground. |
| WDI | Watch dog timer input signal, resets watch dog timer. |
| /XCS, /XRD, /XWR, XA0 | Signals generated by U4 to control display board. |

# Chapter 4: Oximeter Board (LOX) Circuit Description.

## General Description.

LOX Board is an optional board used in the Capnocheck® Plus Monitor when the Oximetry option is selected by the customer. It takes power from the internal isolated Power Supply and communicates with the master microprocessor on the Main board through an optically isolated interface.

## Power Supply

The isolation transformer which powers the LOX board is located on the Main Board. Unregulated +8VDC and -8VDC come to the LOX board through the three pin connector J2. Two voltage regulators: positive U3 and negative U4 convert voltages down to +5VDC and -5VDC.

## Isolated Interface and Reset Circuitry.

Bi-directional communications between LOX board and the Main board are provided through an optically isolated interface built around U1 and U2. Transistor Q1 is used to drive U1's internal LED.

The master microprocessor can reset the LOX microprocessor in case of lost communication caused by an ESD discharge. To do so, it transmits a continuous sequence of "zeroes", which cause the open collector output of U1 to stay pulled down for most of the time. Capacitor C54 slowly charges through R5, and transistor Q6 saturates, thereby, resetting the LOX microprocessor. At power up C21 provides a "normal" reset.

## Microprocessor Circuit and Analog-to-Digital Converter.

The LOX board uses a single chip microcontroller, U5 87C51. It controls the analog front-end Analog-to-Digital Converter (ADC), U6, and communications to the master microprocessor. The clock frequency necessary for the ADC is also generated inside U5 and is equal to 2.4576MHZ. Data to and from the ADC is transferred in synchronous serial mode. ADC U6 contains an internal voltage reference (output 4), which is used throughout all circuitry.

## LED Drive

LED Drive circuitry is used to turn on and off the Oximetry probe LED's, precisely controlling the current through them. The second half of the variable potentiometer U11 (sheet 3) is used to generate voltage between 0 and 2.5VDC. U11 is controlled, serially, by the microcontroller. Operational amplifier U10B together with transistor Q3 create a constant current sink. The current is proportional to the voltage generated by variable potentiometer. The H-bridge Q4-Q5 (sheet 4) is used to activate either LED, red or infrared, inside the Oximeter probe. The following table describes the states of the H-bridge:

| RED-DRV | IR-DRV | /RED-ENBL | /IR-ENBL | Function |
|---|---|---|---|---|
| 1 | 0 | 0 | 1 | Red LED is on |
| 0 | 1 | 1 | 0 | Infrared LED is on |
| 0 | 0 | 1 | 1 | "Open circuit" state |

In this table 1 indicates logic 1, 0 indicates logic 0.

The "Open circuit" state is used to check for a possible probe cable fault. In case of probe cable fault, one of the LED wires can short to the ground shield causing high current through the probe LED. To prevent this, before turning any LED on, the microcontroller checks the cable by "floating" the H-bridge. If the cable is shorted, CON3 and CON2 connections are pulled low, and comparator U13B generates /PRB_FAULT signal, which causes the microcontroller to shut down the LED excitation cycle and generate appropriate message.

## Analog Signal Processing

The differential transconductance amplifier (sheet 4), formed by U12 and U9B, converts the photodetector's current output to a voltage at TP9 (V-AMB). Amplifier U8B offsets the signal at TP9 so the signal baseline is at 3.4 VDC, allowing a wider signal range for the negative-going pulses at TP9.

Comparator U13A is used to inform the microprocessor if U9B is saturated by an excess of ambient light.

V-AMB is passed through blocking capacitor C19 (sheet 3) to remove the signal's DC component. The signal is then buffered and amplified by U9A. Gain is defined by the first channel of digital potentiometer U11. The output of U9A is routed to the integrator-filter-offset circuitry U8A, controlled by

analog switch U7. The output of the integrator is passed through offset stage U10A and then routed to the ADC for measurement.

# Signal Dictionary

This section lists, in alphabetical order, the signal names used on the schematics. The signal's origin, destination, and purpose are described.

## Oximeter Board

| SIGNAL | DESCRIPTION |
|---|---|
| /AMB-FAULT | Signal informing microcontroller about excess of ambient light. |
| AMB | Signal adding offset to the integrator U8A. |
| ANA+5 | The +5 volt power supply VCC is filtered to produce ANA+5. ANA+5 powers the analog circuitry. |
| ANA-5 | The -5 volt power supply is filtered to produce ANA-5. ANA-5 powers the analog circuitry. |
| CAP-GND | Signal used to short blocking capacitor C22 to ground. |
| CKS | CKS is the high-speed, synchronous serial output clock signal. |
| CON2,<br>CON3 | Probe LED's driving signals |
| INTGRAT,<br>RST-INT | Signals used to control integrator U8A. |
| IR-DRV,<br>RED-DRV,<br>/IR-ENBL,<br>/RED-ENBL | Signals used to control MOSFET H-bridge Q4 and Q5, which powers probe LED's. |
| LED-DRV | Signal which defines LED drive current. |
| POT-LD | POT-LD is used to select digital potentiometer chip U11. |
| PRB-DET | PRB-DET is used to inform microcontroller if probe is plugged in. |
| /PRB-FAULT | Signal used to inform microcontroller about probe cable problem. |
| SIGNAL | SIGNAL originates at TP6 and is routed to ADC U6 input. |
| TXS | TXS is the high-speed, synchronous serial output transmitted data signal. |
| TXA1, RXA1 | Asynchronous serial communication signals on the Master side. |
| V-AMB | V-AMB is the output of the front-end differential amplifier. |
| V-R | 2.500 VDC reference voltage. |
| VREF | 3.4 VDC reference voltage. |
| VCC | VCC is the regulated +5 VDC supply generated by +5 volt power supply regulator chip U3 and its discrete components. |
| VSS | Digital ground. |

# Chapter 5: System Testing

## Test Equipment and Tools Required

A. Flow meter.

B. Voltmeter

## Visual Inspection

A. Check that all hardware is secure.

B. Check that all pneumatic connectors are secure.

C. Check that all electrical connectors are properly oriented and securely connected.

D. Check cosmetic appearance and mechanical fit.

E. Check that all labels are properly placed and undamaged.

## Power Supplies

### Main Board

Battery Charger and Power Supply Test

A. Verify charger operation with no battery plugged in by checking the following test point:

1. With the (-) of the DMM to TP1, verify:

   TP2 10.0 ± 0.5 V

B. Verify the power supply operation with battery plugged in by checking the following test point:

1. With the (-) of the DMM connected to TP1, verify:

   TP2 5.0 to 7.2 V (+VBATT), depends on the state of the battery charge

   TP5 250 ± 50 mV (-VBATT), unless in trickle charge mode

   TP8 5.0 ± 0.1 VDC (VRAM)

   TP7 5.00 ± 0.05 V (+5VPWR)

2. With the (-) of the DMM connected to TP5, verify:

   TP3 1100 ± 100 mV, depending on temperature (values assume room temperature)

   TP4 535 ± 50 mV

   TP6 315 ± 100 mV, depending on temperature (values assume room temperature)

3. With the (-) of the DMM connected to J11 pin 2, verify:

   J11 pin 1 7.7 ± 0.2 V

   J11 pin 3 -7.7 ± 0.2 V

### LOX Board

#### Power Supply and Reference

A. Verify power supply operation by checking the following voltages:

1. With the (-) of the DMM connected to TP1, verify:

   TP2 5.0 ± 0.25 V

   TP3 -5.0 ± 0.25 V

   TP10 3.40 V (3.10 to 3.71 V)

## Pneumatics

### Inlet Sample Flow

A. Connect the flowmeter to the moisture trap inlet with the 8 feet sample line.

B. Verify a flow rate of 150 (+20/-10) ml/min.

### Occlusion Verification

A. Occlude sample inlet.

B. Verify that while in occlusion in about 30 seconds.

C. Verify that while in occlusion pump turns on to check if units is still occluded every 5 seconds until the occlusion is removed.

# Appendix

## Parts Lists



## Assembly Drawings and Schematics

| LINE | LEV | LINE/REF | PART NO/DESC | REV | QUANTITY | UM | MAC |
|---|---|---|---|---|---|---|---|
| 0 | 0 | | 58500A1<br>F/ASM TRANSPORT CO2 MONITOR | 4 | 1.000 | EA | M |
| 1 | _1 | 1 | 58519B1<br>CHARGER AC TRANSP CO2/NIBP | 2 | 1.000 | EA | B P |
| 2 | _1 | 2 | 58520B1<br>DISPLAY MODULE TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 3 | _1 | 3 | 70531B1<br>FOOT ADHSV BACK .14 X .5 DIA | 0 | 4.000 | EA | B P |
| 4 | _1 | 4 | 58502B1<br>PWB ASM MAIN BOARD TRANSPORT CO2 A/T | 3 | 1.000 | EA | B P |
| 5 | _1 | 5 | 20509B1<br>RUBBER FOAM W/ADHESIVE | 0 | .250 | EA | B P |
| 6 | _1 | 6 | 58505C1<br>BEZEL W/WINDOW/SCREEN TRANSPORT CO2 | 1 | 1.000 | EA | M P |
| 7 | _1 | 7 | 58506B1<br>CASE TOP HALF TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 8 | _1 | 8 | 58507B1<br>CASE BOTTOM HALF TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 9 | _1 | 9 | 58516C1<br>CASE BACK PANEL W/SCREENING TRANS CO2 | 0 | 1.000 | EA | M P |
| 10 | _1 | 10 | 58514B1<br>FILTER HOLDER MOLDED TRANSPORT CO2 | 0 | 2.000 | EA | B P |
| 11 | _1 | 11 | 58509B1<br>KEYPAD SET LEFT/RIGHT TRANSPORT CO2 | 7 | 1.000 | EA | B P |
| 12 | _1 | 12 | 58511B1<br>BRACKET DISPLAY TRANSPORT CO2 | 2 | 2.000 | EA | B P |
| 13 | _1 | 14 | 71221B1<br>PIN CASE HANDLE NEWOX4 | 0 | 2.000 | EA | B P |
| 14 | _1 | 15 | 70782A7<br>SPEAKER ASM CO2 TRANS/NIBP | 1 | 1.000 | EA | M P |
| 15 | _1 | 17 | 72083B1<br>INSULATOR FORMEX TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 16 | _1 | 18 | 53130B1<br>CABLE ASSEMBLY RIBBON SOCKET/SOCKET | 3 | 1.000 | EA | B P |
| 17 | _1 | 19 | 20002B5<br>FILTER MOISTURE TRAP TRANSPORT 10/PKG | 2 | .100 | EA | B P |
| 18 | _1 | 20 | 20632B2<br>FILTER CO2 ABSORBER TRANSPORT 2/PKG | 1 | .500 | EA | B P |

| LINE | LEV | LINE/REF | PART NO/DESC | REV | QUANTITY | UM | MAC |
|---|---|---|---|---|---|---|---|
| 19 | _1 | 21 | 58525A1<br>PUMP ASSEMBLY TRANSPORT CO2 | 2 | 1.000 | EA | M P |
| 20 | _1 | 22 | 71070B3<br>BENCH TRANSPORT CO2 | 1 | 1.000 | EA | B P |
| 21 | _1 | 23 | 58522B1<br>BATTERY PACK TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 22 | _1 | 24 | 58524A1<br>FAN ASSEMBLY TRANSPORT CO2 | 1 | 1.000 | EA | M P |
| 23 | _1 | 25 | 31009B1<br>SPACER VIBRATION TRANSPORT CO2 NIBP | 0 | 4.000 | EA | B P |
| 24 | _1 | 26 | 71220B1<br>CASE HANDLE NEWOX4/NIBP/TRANSCO2 | 1 | 1.000 | EA | B P |
| 25 | _1 | 27 | 31010B1<br>PALNUT SELF CUTTING | 1 | 3.000 | EA | B P |
| 26 | _1 | 28 | 12029B1<br>SPACER 3/16 X 5/32 UNTHREADED ALUMINUM | 0 | 2.000 | EA | B P |
| 27 | _1 | 29 | 12005B2<br>SCREW 4-40 X 1/2 PHMS PHILLIPS | 0 | 5.000 | EA | B P |
| 28 | _1 | 30 | 12026B3<br>SCREW TAPPING 4 X 1/4 TYPE B PHILLIPS PAN HD | 0 | 2.000 | EA | B P |
| 29 | _1 | 31 | 12003B7<br>SCREW 4-40 X 1/4 FHMS PHILLIPS | 0 | 1.000 | EA | B P |
| 30 | _1 | 32 | 12005B24<br>SCREW 4-40 X 1/8 PHMS PHILLIPS | 0 | 4.000 | EA | B P |
| 31 | _1 | 33 | 12008B2<br>NUT HEX 4-40 | 0 | 4.000 | EA | B P |
| 32 | _1 | 34 | 12015B1<br>WASHER LOCK #4 EXT | 0 | 14.000 | EA | B P |
| 33 | _1 | 35 | 12005B8<br>SCREW 6-32 X 1/4 PHMS PHILLIPS | 0 | 4.000 | EA | B P |
| 34 | _1 | 36 | 30182B1<br>ADHESIVE THREADLOCK LOCTITE 242 | 0 | .000 | BT | B P |
| 35 | _1 | 37 | 71237B1<br>SHIM BATTERY FOAM RUBBER NEWOX4 | 0 | 1.000 | EA | B P |
| 36 | _1 | 38 | 70875B1<br>LINE SAMPLE ASM NAFION 1' | 1 | 1.000 | EA | B P |

| LINE | LEV | LINE/REF | PART NO/DESC | REV | QUANTITY | UM | MAC |
|---|---|---|---|---|---|---|---|
| 37 | _1 | 39 | 20635B3<br>TUBING ASSEMBLY TRANSPORT CO2 | 4 | 1.000 | EA | B P |
| 38 | _1 | 40 | 54068B<br>TIES CABLE MINIATURE | 0 | 1.000 | EA | B P |
| 39 | _1 | 41 | 58526B1<br>CABLE ASM DISPLAY POWER TRANSPORT CO2 | 1 | 1.000 | EA | B P |
| 40 | _1 | 42 | 71012B14<br>LABEL INFORMATIVE NEWOX4/TRANS CO2 | 0 | 1.000 | EA | B P |
| 41 | _1 | 47 | 20495B1<br>LABEL Q-LINE SMALL | 0 | 1.000 | EA | B P |
| 42 | _1 | 51 | 31012B3<br>POST MINI SUPPORT TRANSPORT CO2 | 2 | 3.000 | EA | B P |
| 43 | _1 | 52 | 58523B1<br>BOOT FAN CORNER TRANSPORT CO2 | 0 | 4.000 | EA | B P |
| 44 | _1 | 53 | 58531B1<br>BRACKET BATTERY TRANSPORT CO2 | 2 | 1.000 | EA | B P |
| 45 | _1 | 54 | 20038B1<br>CONN LUER FEMALE TAPER .09 | 1 | 2.000 | EA | B P |
| 46 | _1 | 55 | 20264B1<br>NUT 1/4-28 | 0 | 2.000 | EA | B P |
| 47 | _1 | 56 | 31083B1<br>ADHESIVE POLYURETHANE DUAL-PAK | 0 | .000 | TB | B P |
| 48 | _1 | 57 | 12009B3<br>NUT KEPS 6-32 | 0 | 1.000 | EA | B P |
| 49 | _1 | 58 | 12003B5<br>SCREW 6-32 X 3/8 FHMS PHILLIPS | 0 | 1.000 | EA | B P |
| 50 | _1 | 59 | 57959B1<br>TAPE KAPTON INSULATING 1/2" | 1 | .042 | RL | B P |
| 51 | _1 | 60 | 12005B6<br>SCREW 4-40 X 5/16 PHMS PHILLIPS | 0 | 1.000 | EA | B P |
| 52 | _1 | 61 | 70868B14<br>INSULATOR TRANSPORT CO2 | 0 | 1.000 | EA | B P |
| 53 | _1 | 62 | 20542C78<br>LABEL US PATENT 5,386,833 | 7 | 1.000 | EA | M P |
| 54 | _1 | 63 | 68061B1<br>TUBING TYGON B-44-3 .125 OD X .062 ID | 0 | .146 | FT | B P |

| LINE | LEV | LINE/REF | PART NO/DESC | REV | QUANTITY | UM | MAC |
|---|---|---|---|---|---|---|---|
| 55 | _1 | 64 | 68108B4<br>SAMPLE LINE 8' PE-PVC | 0 | .344 | EA | B P |
| 56 | _1 | 65 | 56239B1<br>TAPE DOUBLE-SIDED FOAM 1/2"W X 1/32"T | 0 | .333 | FT | B P |
| 57 | _1 | 66 | 58473B1<br>PLATE CLOSING DB9 TRANSPORT CO2 | 1 | 1.000 | EA | B P |
| 58 | _1 | 67 | 20542C110<br>LABEL MODIFIED U.S. PAT. NO. | | 1.000 | EA | M P |
| 59 | _1 | 68 | 31062B4<br>LABEL CSA TUV CHARGER 1614 1615 | 0 | 1.000 | EA | B P |

| QTY | DESIGNATION(S) | DESCRIPTION | MANUFACTURER/PART NO. |
|---|---|---|---|
| 1 | BT1 | Lithium Battery 3V, BR2330 | Panasonic BR2330-1VC or similar |
| 2 | C1,C2 | 10pF NPO 50V 5% 1206 SMT | Any |
| 53 | C3,C4,C5,C6,C7,C8,C9,C10, C11,C13,C14,C15,C16,C17, C18,C20,C23, C25,C26, C30, C31,C32,C33,C34,C35, C36, C38,C41,C44,C46,C50, C52, C56,C57,C62,C64,C66, C69, C70,C73,C75,C82,C83, C84, C86,C88,C89.C90,C91, C92, C93,C40,C65 | .1uF 50V 10% X7R 1206 SMT | Any |
| 4 | C12,C45,C54,C59 | 1uF 16V 10% TANT 3216 SMT | T491A105K016AS KEMET or Any |
| 4 | C22,C37,C60,C61 | .01uF 50V 10% X7R 1206 SMT | Any |
| 5 | C19,C43,C47,C48,C51 | 220pF NPO 50V 5% 1206 SMT | Any |
| 5 | C21,C27,C28,C29,C49 | 68pF NPO 50V 5% 1206 SMT | Any |
| 2 | C55,C39 | 10uF 16V 10% TANT 6032 SMT | T491C106K016AS KEMET or Any |
| 3 | C42,C68,C76 | 1uF,50V,POLY | Panasonic ECQ-V1H105JL or similar |
| 1 | C53 | 6800uF,35V | Panasonic ECO-S1VP682CA or similar |
| 1 | C58 | 180uF,35V,LOW ESR | Panasonic ECA-1VFQ181 |
| 6 | C63,C67,C74,C77,C80,C81 | 56uF,16V,LOW ESR | Panasonic ECA-1CFQ560 |
| 2 | C71,C78,C87 | 330uF,6.3V | Panasonic ECA-0JFQ331 |
| 1 | C72 | 1200uF,6.3V | Panasonic ECA-0JFQ122L |
| 2 | C85,C79 | 22pF NPO 50V 5% 1206 SMT | Any |
| 1 | C94 | 5.6pF NPO 50V ±0.5±F 1206 SMT | Any |
| 7 | D1,D5,D6,D7,D9,D10,D11 | BAV99LT1 SOT-23 | Any |
| 1 | D2 | SMBG48A | TAITRON or TGL41-47A or TGL41-43A |
| 2 | D3,D4 | MBR745 | TAITRON or MOTOROLA or MBR1035 INTERNATIONAL RECTIFIER, |
| 9 | FB1,FB2,FB3,FB4,FB5,FB6, FB7,FB16,FB17 | KCB-1206 1206 SMT | Associated Components |
| 8 | FB8,FB9,FB10,FB11,FB12, FB13,FB14,FB15 | CAPACITOR FEED 470pF | MURATA NFM40R11C471 or NFM40R11C102 |
| 6 | FB18,FB19,FB20,FB21,FB22, FB23 | BLM21A601S | MURATA BLM21A601S |
| 1 | JP1 | 2 POS SIL HEADER .1" | MOLEX 22-03-2021 or similar |
| 1 | J1 | CON5 SIL .1" | 3M 926781-01-05-I |
| 1 | J2 | CON26 DIL HEADER | 88880-074 or 88880-051 Berg Electronics or 3M 2526-6002UG |
| 2 | J3,J4 | 6 POS CONNECTOR | TRIO MATE 520315-6 AMP |
| 3 | J5,J6,J13 | 2 POS SIL LOCK. HEADER .1" | 640456-2 AMP or similar (20412B1) |
| 1 | J7 | DB25 FEMALE RIGHT ANG. | 747238-3 AMP or similar |
| 1 | J8 | RJ-11 | MOLEX 95009-2661or SPC Teck. TA-250-6 (70949B1) |

ORIGINAL

| QTY | DESIGNATION(S) | DESCRIPTION | MANUFACTURER/PART NO. |
|---|---|---|---|
| 1 | J9 | POWERJACK | DJ005B LZR |
| 1 | J10 | CON3 LOCK. .156" | 26-48-1035 MOLEX or similar |
| 1 | J11 | CON3 SIL .1" | 3M 926781-01-03-I |
| 1 | J12 | CON2 LOCK. .156" | 26-48-1025 MOLEX or similar |
| 1 | L1 | 68uH,3.5A | HURRICANE LABS HL-EI168M/AB |
| 1 | L2 | 10uH,2A | HURRICANE LABS HL-EI110P/AB |
| 1 | MP1 | MPX5100AP | PRESSURE SENSOR OR MOTOROLA |
| 6 | Q1,Q2,Q3,Q8,Q9,Q10 | MMBTA3906LT1 | SOT-23, Any |
| 1 | Q4 | SI9955DY | SILICONIX, or SI9956DY SILICONIX, or IRF7101 or IRF7103 or IRF7105 Intern'l Rectifier, or DID2009 or DID2003 Diodes Inc. |
| 1 | Q5 | MMBTA55LT1 | SOT-23, Any |
| 3 | Q6,Q7,Q13 | MMBTA05LT1 | SOT-23, Any |
| 1 | Q11 | IRFZ40 | TO-220, INTERNATIONAL RECTIFIER |
| 1 | Q12 | 2N7002 | SOT-23, Any |
| 1 | Q14 | SI9942DY | SILICONIX, or SI9952DY SILICONIX, or DID2002 Diodes Inc |
| 8 | R1,R12,R13,R14,R15,R16, R39,R58,R82 | 2.49K, 1% | 1206 SMT |
| 5 | R2,R3,R38,R74 | 806K, 1% | 1206 SMT |
| 2 | R83,R84 | 82, 5% | 1206 SMT |
| 7 | R5,R6,R18,R20,R22,R44, R47 | 270, 5% | 1206 SMT |
| 14 | R7,R8,R9,R10,R11,R32,R40, R41, R43,R66,R67,R70,R71,R76 | 100K, 1% | 1206 SMT |
| 7 | R17,R19,R21,R29, R37,R55,R68 | 11K, 1% | 1206 SMT |
| 9 | R25,R26,R42,R50,R59,R60, R78,R79,R87 | 53.6K, 1% | 1206 SMT |
| 6 | R27,R28,R30,R61,R69 | 19.6K, 1% | 1206 SMT |
| 1 | R31 | 150K, 1% | 1206 SMT |
| 6 | R33,R34,R35,R56,R77,R80 | 1.8K, 5% | 1206 SMT |
| 1 | R45 | 49.9,.1%,.5W | PRP GP1/2TC50 49.9Ohm .1%, |
| 6 | R46,R49,R51,R52,R53,R54 | 51, 5% | 1206 SMT |
| 1 | R48 | R-PACK CO2 | SO-8, OHMTEK, BCI P/N 10019B1, OHMTEK P/N 106-437 |
| 1 | R57 | 470, 5% | 1206 SMT |
| 1 | R63 | .18 ohm or .2 ohm, 5%, 1W | K-TRONICS MWW1 .18 OHM 5% or MWW1 .2 OHM 5% |
| 1 | R64 | 590K,0.1% | PRP GP1/4 TC50 590K .1% |
| 1 | R65 | 200K,0.1% | PRP GP1/4 TC50 200K .1% |
| 4 | R36,R72,R73,R81 | 5.1K, 5% | 1206 SMT |
| 1 | R75 | 240K, 5% | 1206 SMT |
| 3 | R85,R86,R88 | 200, 1% | 0805 SMT |

ORIGINAL

| QTY | DESIGNATION(S) | DESCRIPTION | MANUFACTURER/PART NO. |
|---|---|---|---|
| 17 | TP1,TP2,TP3,TP4,TP5,TP6, TP7,TP8,TP9,TP10,TP11, TP12,TP13,TP14,TP15,TP16, TP17 | Test Point | TP-103-03 COMPONENTS CORP. or similar |
| 1 | T1 | Common Mode Choke | PLT09H-2003R MURATA |
| 2 | T3,T4 | 10K @ 25C,-4.41%/C | KC003T Keystone |
| 1 | T5 | TR ISO 3 | BCI P/N 58513B1 Rev. C, INGLOT P-5892 |
| 1 | U1 | Z8S18020VSC | Zilog |
| 1 | U2 | 27C010 PLCC | AT27C010L-15JC or AT27C010-15JC ATMEL or NM27C010V150 NATIONAL SEM. |
| 1 | (U2) | SOCKET 821977-1 | AMP |
| 1 | U3 | HM628128LFP-8 | Hitachi or similar |
| 1 | U4 | EPM7032TC44-15(or faster) | Altera |
| 2 | U5,U6 | 74HC245 | SMT, Any |
| 2 | U7,U8 | 74HC259 | SMT, Any |
| 1 | U9 | MAX512CSD | Maxim |
| 1 | U10 | LT1181ACS | Linear Technology or MAX202ECWE Maxim |
| 1 | U11 | DS1202S8 | Dallas Semiconductor |
| 1 | U12 | LM324M | SO-14, National Semi. or any |
| 1 | U13 | AD822AR | Analog Devices |
| 1 | U14 | AD7858LAR | Analog Devices |
| 1 | U15 | OP284FS | Analog Devices |
| 1 | U16 | AD780AR | Analog Devices |
| 1 | U17 | MAX713CSE | MAXIM |
| 1 | U18 | LT1074CT | Linear Technology |
| 1 | U19 | MAX690ACSA | MAXIM |
| 1 | U20 | MIC5157BM | Micrel |
| 1 | U21 | 74HC132 | SMT, Any |
| 1 | U100 | 20 PIN 0.4" SOCKET | Mill-Max P110-13-420-41-001000 |
| 1 | V1 | VALVE 3-WAY | LFAA0503418H LEE CO. |
| 1 | X1 | 18.432MHZ | EPSON CA-301 18.432M-C |
| 1 | X2 | 32768Hz | M-TRON MMCC-1-32.768 KHZ, BCI 70327B1 |
| 1 | 400 | PWB FAB | BCI P/N 58501B1 |
| 6 | 401 | #4-40 X 1/4 SCREW | BCI P/N 12005B1 |
| 2 | 402 | 6/32 X 5/8 NYLON SCREW | Any |
| 2 | 403 | 6/32 NYLON NUT | BCI P/N 20161B2 |
| 3 | 404 | #4 WASHER LOCK EXT. | BCI P/N 12015B1 |
| 3 | 405 | SHOLDER WASHER | BCI P/N 20308B1 |
| 4 | 406 | SIL-PAD | BCI P/N 56228B4 |
| 1 | 408 | HEAT SINK | BCI P/N 58515B1 |
| 2 | 409 | J7 HARDWARE | BCI P/N 20522B2 |
| 1 | 500 | EMI SHIELD | BCI P/N 58532B1 |
| 1 | 501 | SOFTWARE ASM. | BCI P/N 58512A1 |
| 2 | 502 | #4-40 X 5/16 SCREW | BCI P/N 12005B6 |
| 2 | 503 | #4-40 NUT HEX (SMALL PAT) | BCI P/N 49041B2 |

ORIGINAL

| QTY | DESIGNATION(S) | DESCRIPTION | MANUFACTURER/PART NO. |
|---|---|---|---|
| 2 | 504 | #4 SPLIT RING WASHER | BCI P/N 12019B3 |
| A/R | 505 | HOT GLUE, FULLER HM-2124 | BCI P/N 58326B1 |
| A/R | 506 | RTV 162, SILICONE | BCI P/N 57293B1 |
| .167 | 507 | TAPE KAPTON INSULATING | BCI P/N 57959B1 |
| 4 | 508 | #6 WASHER, FLAT .031 THK. | BCI P/N 53055B2 |

NOTES:

1) U4 MUST BE PROGRAMMED BEFORE INSTALLATION, CONTACT BCI FOR INSTRUCTIONS
2) R48 IS A CUSTOM RESISTOR NETWORK MANUFACTURED BY OHMTEK. CONTACT BCI FOR INSTRUCTIONS.
3) BATTERY BT1 IS INSTALLED MANUALLY AFTER ALL COMPONENTS ARE INSTALLED.

ORIGINAL

| DESCRIPTION | QTY | DESIGNATION(S) | MANUFACTURER'S PART NO. |
|---|---|---|---|
| .1uF,50V,20% | 27 | C1,C3,C6,C7,C9,C11, C13,C14,C15,C17,C19, C23,C24,C26,C27,C30, C31,C32,C33,C35,C41, C43,C49,C50,C51,C52, C54 | 0805 Z5U SMT,Any |
| 33pF,6000V | 1 | C2 | SPRAGUE 60GAQ33 |
| 10pF,50V,5% | 4 | C4,C5,C29,C53 | 0805 NPO SMT,Any |
| .01uF,50V,10% | 2 | C8,C10 | 0805 X7R SMT,Any |
| 10uF,TANT,16V | 5 | C12,C18,C20,C34,C36 | 6032 TANT SMT,Any |
| 100uF,6.3V | 1 | C16 | 107RSS6R3M ILLINOIS CAP. |
| 1uF,TANT,16V | 2 | C21,C42 | 3216 SMT,Any |
| .1uF,POLY | 1 | C22 | ECQ-V1H104JZ3 PANASONIC |
| 6800pF,2% | 1 | C25 | ECQ- P1H682GZ PANASONIC OR WIMA FKP2 6800pF 63V |
| 1nF,NPO | 1 | C28 | 0805 NPO SMT, ECU-V1H102JCX PANASONIC OR Any |
| 68pF,50V,5% | 2 | C37,C38 | 0805 NPO SMT,Any |
| 220pF,50V,5% | 2 | C39,C40 | 0805 NPO SMT,Any |
| 470uF,10V,LOW ESR | 1 | C48 | ECA-1AFQ471 PANASONIC |
| BAV99LT1<br>or BAV99TR<br>or BAV99TA | 2 | D1,D2 | SOT-23 MOTOROLA<br>DIODES INC.<br>ZETEX |
| BLM41A01PT | 1 | FB1 | MURATA ERIE |
| CON5 | 1 | J1 | MOLEX 22-17-2052 |
| CON3 | 1 | J2 | MOLEX 22-17-2032 |
| 7 POS HEADER | 1 | J3 | 926141-01-07-I 3M |
| COM MODE INDUCTOR 15uH | 1 | L1 | * BCI P/N 71138B1 |
| MMBTA55LT1 | 3 | Q1,Q2,Q6 | SOT-23,MOTOROLA |
| MMBTA05LT1<br>or MMBTA06LT1 | 1 | Q3 | SOT-23,MOTOROLA |
| SSD2005 | 1 | Q4 | SAMSUNG SSD2005 OR T.I. TPS1120 OR DIODES INC. DID2005 OR INT'L RECTIFIER IRF7104 |
| SSD2003 | 1 | Q5 | SAMSUNG SSD2003 OR INT'L RECTIFIER IRF7101,IRF7103 OR DIODES INC. DID2003, DID2009 OR SILICONIX, SI9956 |
| 11K,1% | 13 | R1,R2,R4,R13,R14, R29,R30,R31,R32, R36,R46,R49,R50 | 0805 SMT,Any |
| 1K,5% | 2 | R3,R12 | 0805 SMT,Any |
| 249K,1% | 10 | R5,R6,R7,R8,R9,R11, R22,R27,R28,R41 | 0805 SMT,Any |
| 44.2K,1% | 5 | R15,R42,R45,R47,R48 | 0805 SMT,Any |
| 24.9K,1% | 5 | R16,R34,R35,R37,R38 | 0805 SMT,Any |
| 47,5% | 3 | R17,R23,R24 | 0805 SMT,Any |

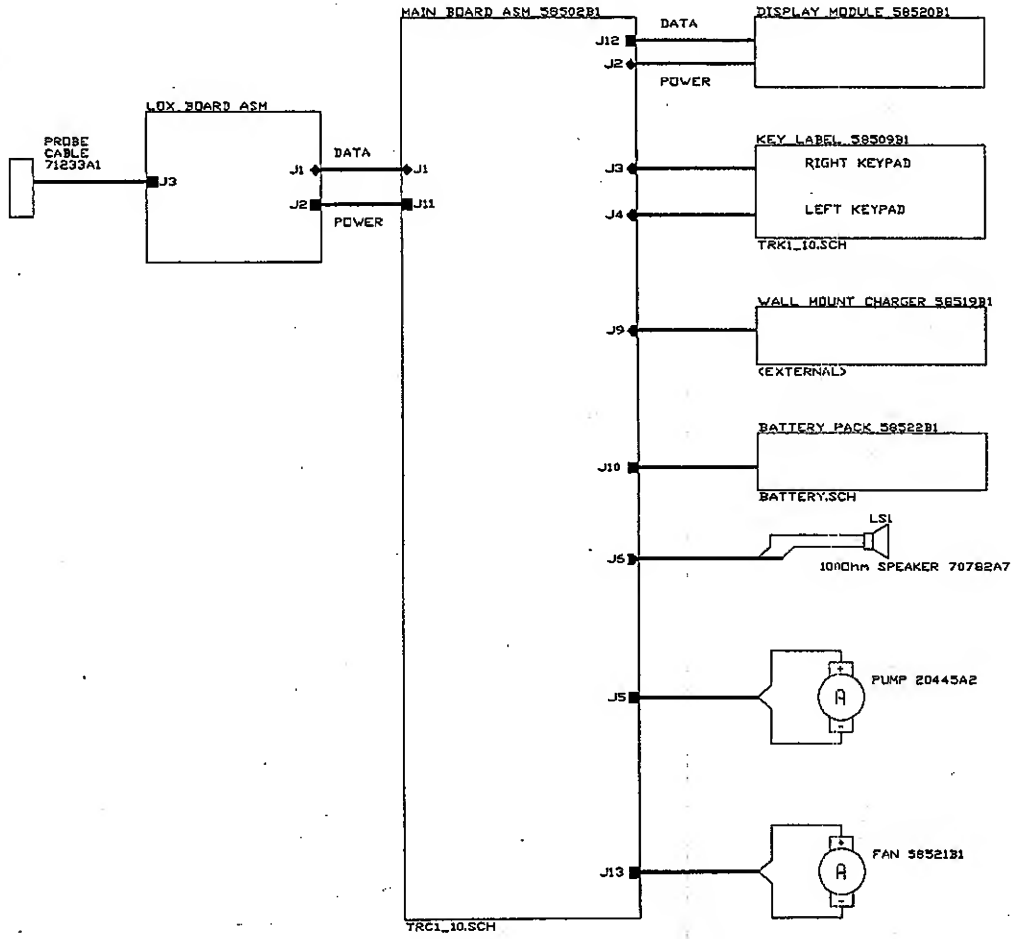
ORIGINAL

| DESCRIPTION | QTY | DESIGNATION(S) | MANUFACTURER'S PART NO. |
|---|---|---|---|
| 15,1% | 2 | R18,R19 | 0805 SMT,Any |
| 270,5% | 2 | R20,R33 | 0805 SMT,Any |
| 2.15K,1% | 7 | R21,R25,R26,R39,R40, R43,R44 | 0805 SMT,Any |
| TEST POINT | 10 | TP1,TP2,TP3,TP4,TP5, TP6,TP7,TP8,TP9,TP10 | TP-103-03 COMPONENTS CORP. |
| PC900V | 2 | U1,U2 | DIP-8,SHARP |
| MC78L05ACD | 1 | U3 | SO-8,MOTOROLA or uA78L05ACD TI |
| MC79L05ACD | 1 | U4 | SO-8,MOTOROLA or TI |
| 87C51PLCC | 1 | U5 | AT89C51-16J ATMEL |
| AD7853AR | 1 | U6 | SOL-24 (WIDE),ANALOG DEVICES |
| DG308ACY | 1 | U7 | SO-16,SILICONIX, MAXIM, or HARRIS |
| TLC272CD | 2 | U8,U12 | SO-8,TI |
| AD822AR | 1 | U9 | SO-8,ANALOG DEVICES |
| OP283GS | 1 | U10 | SO-8,ANALOG DEVICES |
| DS1267S-10 | 1 | U11 | SOL-16 (WIDE),DALLAS SEM. |
| LM393M | 1 | U13 | SO-8,NATIONAL SEMICONDUCTOR |
| 14.7456MHZ | 1 | X1 | EPSON CA-301 14.7456M-C |
| PWB FAB | 1 | 400 | BCI P/N 58455B1 |
| SOFTWARE ASM | 1 | 401(SEE NOTE 3) | * BCI P/N 58463A1 |
| SOCKET, PLCC | 1 | SKT1 | AMP 822275-1 or EQUIVALENT |
| COVER SHIELD | 1 | 402 | BCI P/N 71017B1 |
| BARRIER INSULATING | 1 | 403 | * BCI P/N 20511B1 |
| CAPACITOR .33uF 50V 10% | 1 | 404 | BCI P/N 13000B32 |

ORIGINAL

* INDICATES PARTS SUPPLIED BY BCI.

| DRWG NO: 58500S1 | |
|---|---|
| REV. | DESCRIPTION |
| | |




BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: CLL | CHK. BY: | ENG. APPR.: |
| DATE: 1-27-97 | DATE: | DATE: |
| SCALE: N/A | DO NOT SCALE PRINT | Q.A. APPR.: |
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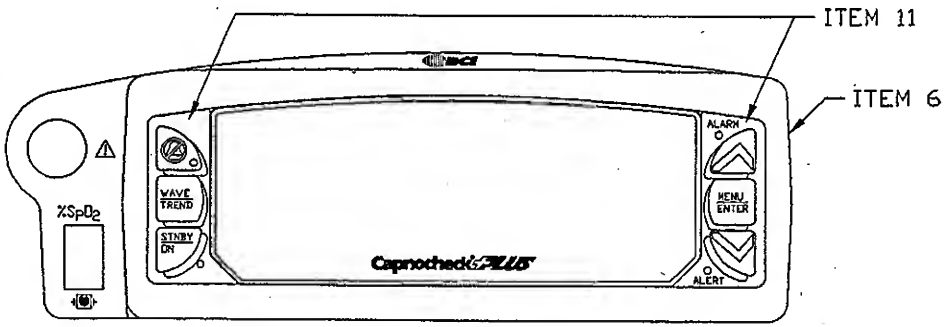
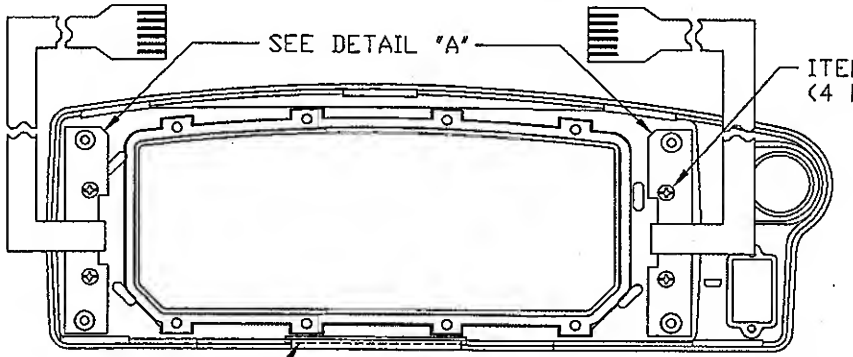
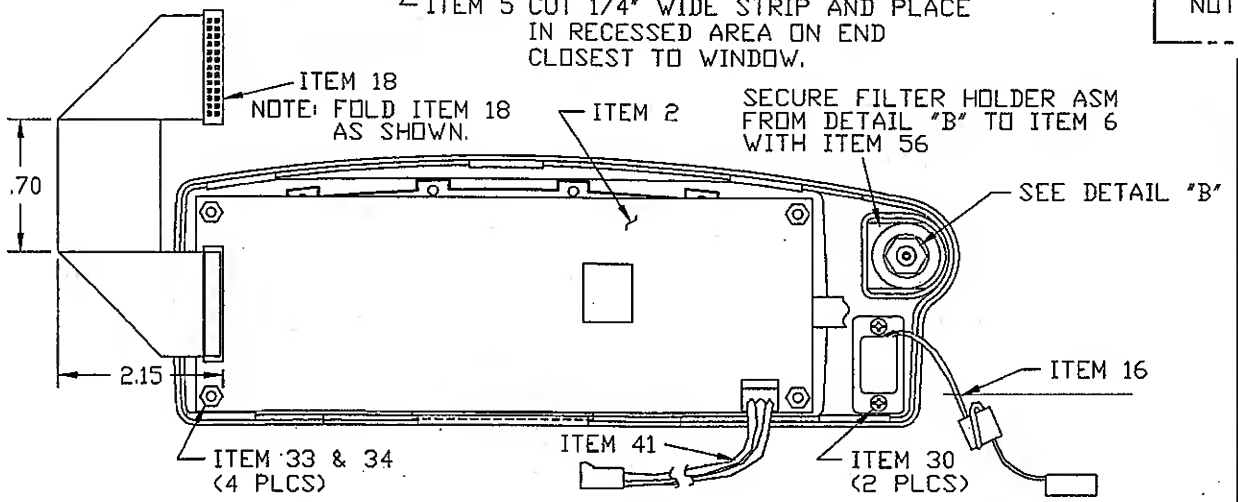
| | | MFG. APPR.: |
| | | DATE: |
| TITLE: SYSTEM SCHEMATIC CO2 TRANSPORT | | DRWG NO: 58500S1 REV. 0 |
| | | SHT. 1 OF 1 |

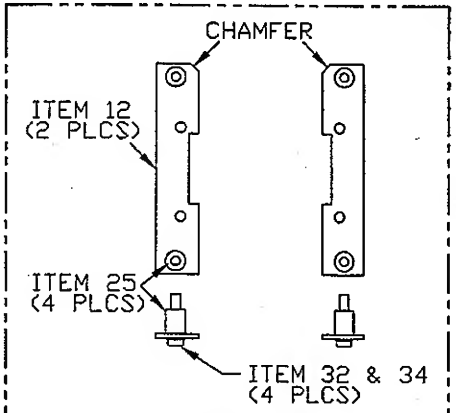
A-11



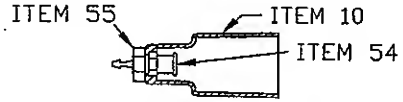

ITEM 5 CUT 1/4" WIDE STRIP AND PLACE IN RECESSED AREA ON END CLOSEST TO WINDOW.




DETAIL "A"

NOTE: ASSEMBLY TWO BRKTS, NOTE ORIENTATION OF CHAMFER.




DETAIL "B"

NOTE: ASSEMBLY TWO FILTER HOLDERS.

ORIGINAL

| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96 |
| 2 | SEE SHTS 3, 4 & 5. C/N#2983 SDP 2-25-97 |
| 3 | SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97 |
| 4 | SEE SHEET 6. C/N#3097 MER 6-30-97 |
| 5 | ADDED ITEM 49, SEE SHEET 2. C/N 4235 CLL 12-3-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR. E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: J.M.PETER |
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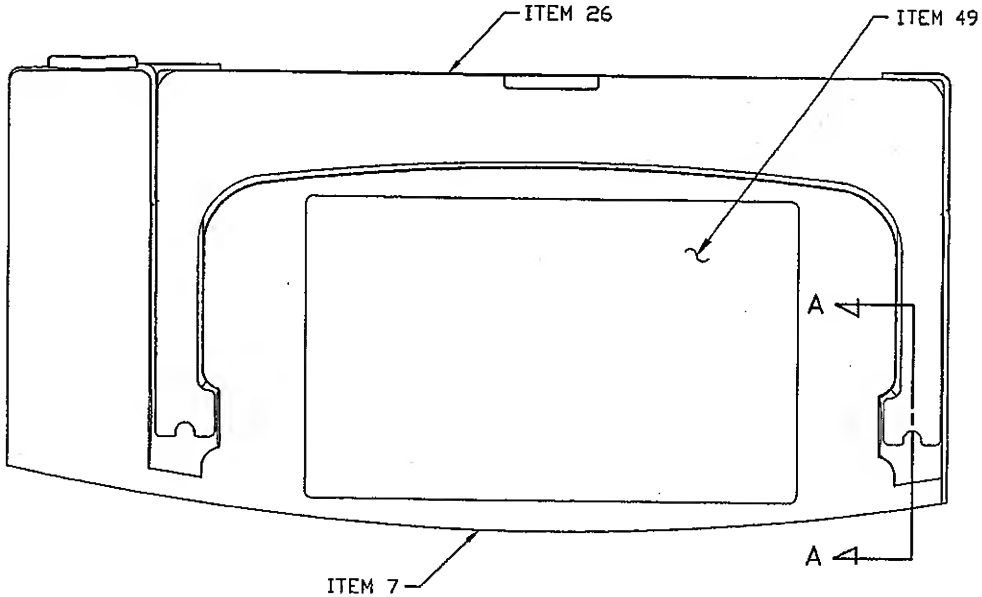
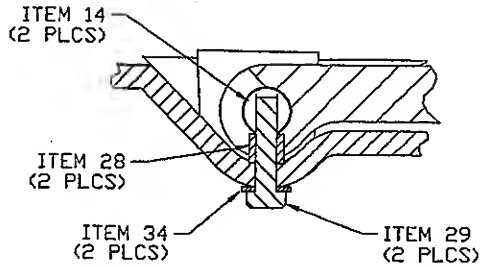
| | | MFG. APPR.: MS |
| MATERIAL: | | DATE: 8-16-96 |
| FINISH: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| TITLE: F/ASM TRANSPORT CO2 MONITOR (BEZEL) | | DRWG NO: 58500A1 REV. 5 |
| | | SHT. 1 OF 6 |

A-12

| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96 |
| 2 | SEE SHT'S 3, 4 & 5, C/N#2983 SDP 2-25-97 |
| 3 | SEE SHEETS 4 & 6, C/N#4045 MER 6-19-97 |
| 4 | SEE SHEET 6, C/N#3097 MER 6-30-97 |
| 5 | ADDED ITEM 49 C/N#4235 CLL 12-3-97 |




ORIGINAL




SECTION A-A

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR. E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
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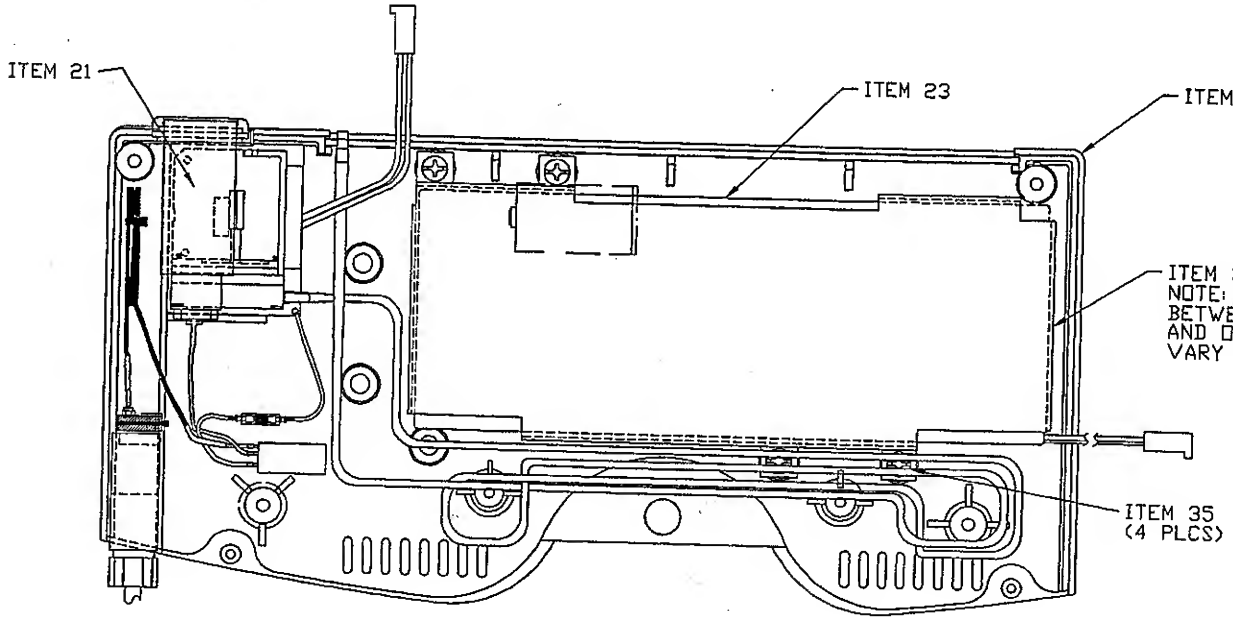
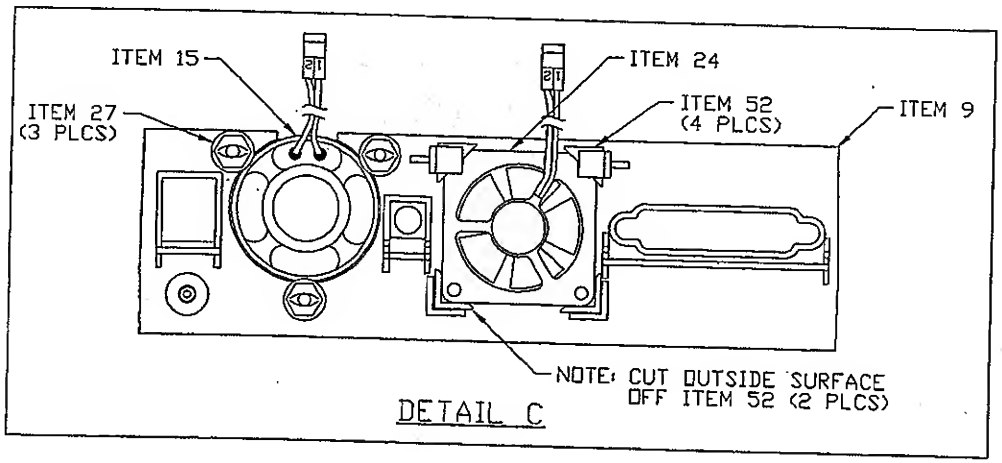
| | | MFG. APPR.: MS |
| | | DATE: 8-16-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| FINISH: | | |
| TITLE: F/ASM TRANSPORT CO2 MONITOR (TOP & HANDLE) | | DRWG NO: 58500A1 REV. 5 |
| | | SHT. 2 OF 6 |

A-12




DETAIL C

| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | REVISED IT.S 37 & 53 NOTES. ROTATED SPEAKER TO POSITION WIRES ON TOP ALSO SEE SHTS 5 & 6. C/N'S 2716 & 2730 SDP/CLL 11-13-96 |
| 2 | ADDED NEW PUMP & TUBING ASSEMBLY. C/N#2983 SDP2-24-97 |
| 3 | SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97 |
| 4 | SEE SHEET 6. C/N#3097 MER 6-30-97 |
| 5 | SEE SHEET 2. C/N#4235 CLL 12-3-97 |

ORIGINAL

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR. E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
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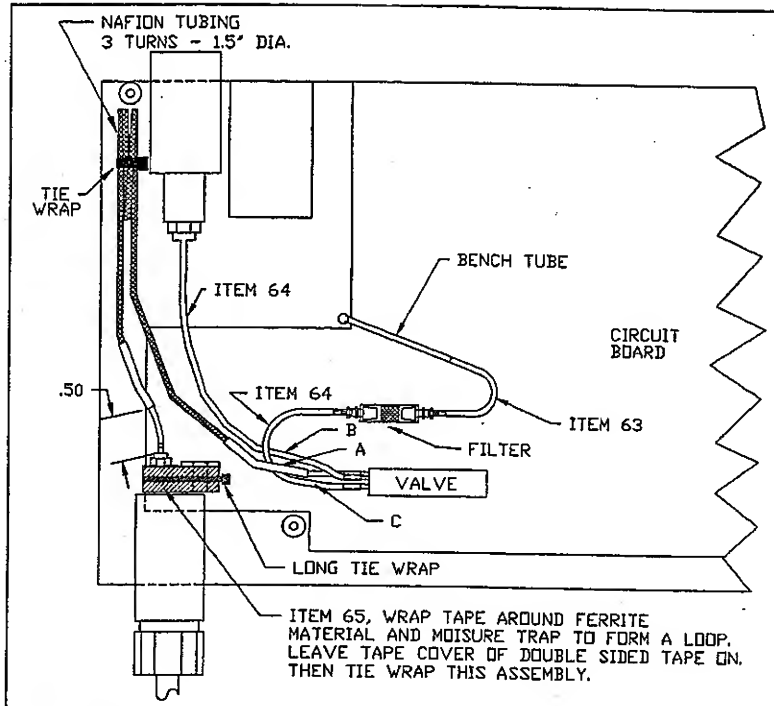
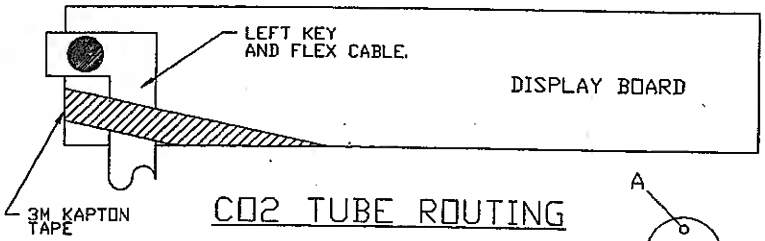
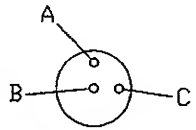
| | | MFG. APPR.: MS |
| | | DATE: 8-16-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| FINISH: | | |
| TITLE: F/ASM TRANSPORT CO2 MONITOR (BOTTOM & BACK PANEL) | DRWG NO: 58500A1 | REV. 5 |
| | SHT. 3 OF 6 | |

A-14

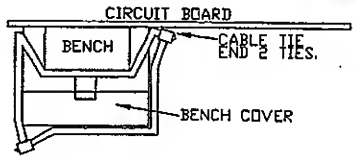


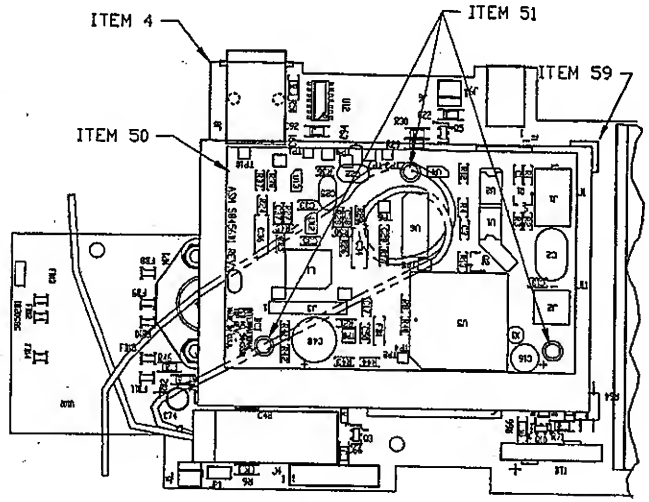




CO2 TUBE ROUTING




VALVE FRONT VIEW




OXIMETER AND MAIN PWB ASM

NOTE: FOLD 2 SIDES OF ITEM 17 UP AND TAPE TOGETHER WITH ITEM 59 BEFOR INSTALLING.

ORIGINAL

| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96 |
| 2 | COMPLETELY REVISED TUBE ROUTING. ADDED ITEMS 17 & 59. ALSO SEE SHEETS 3 & 5. C/N 2983 SDP 2-25-97 |
| 3 | REMOVED ITEM 17. SEE SHEET 6. C/N 4045 MER 6-19-97 |
| 4 | SEE SHEET 6. C/N 3097 MER 6-30-97 |
| 5 | SEE SHEET 2. C/N 4235 CLL 12-3-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR: E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR: J.M.PETER |
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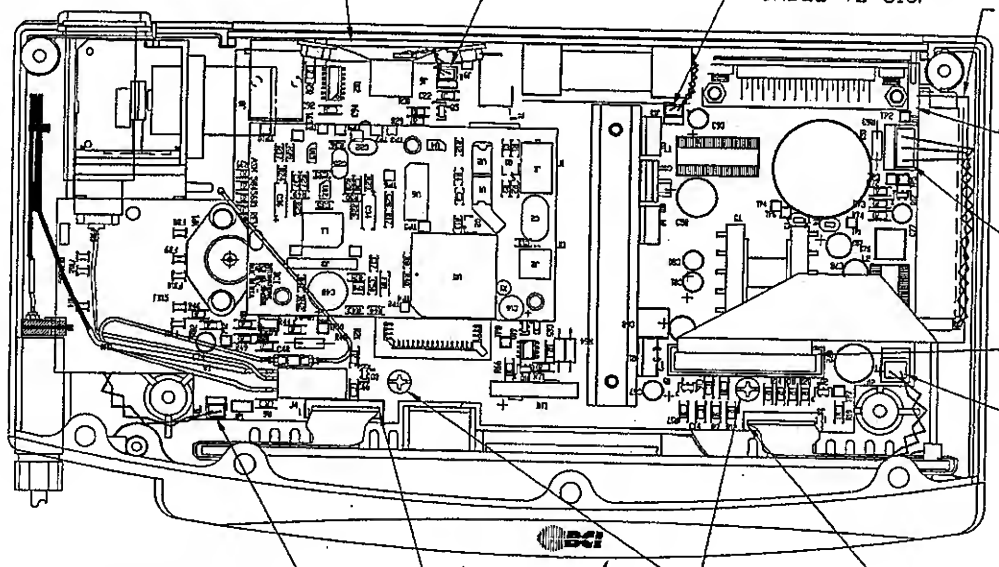
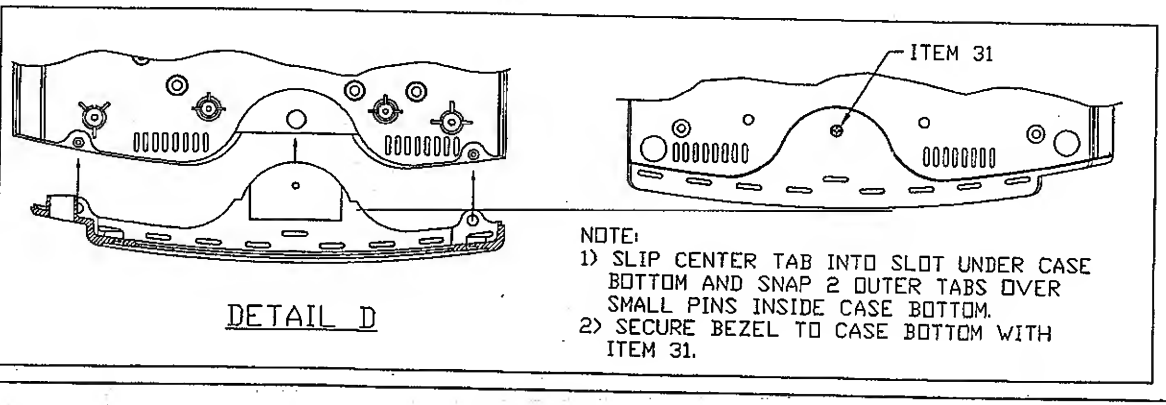
| | | MFG. APPR: MS |
| | | DATE: 8-16-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| FINISH: | | |
| TITLE: F/ASM TRANSPORT CO2 MONITOR (TUBING & OXI/MAIN PWB ASM) | DRWG NO: 58500A1 | REV. 5 |
| | SHT. 4 OF 6 | |

A-15




| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | ADDED ITEM 61 ALSO SEE SHT'S 3 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96 |
| 2 | REDREW TO REFLECT NEW PUMP ASM. C/N#2983 SDP2-25-97 |
| 3 | SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97 |
| 4 | SEE SHEET 6. C/N#3097 MER 6-30-97 |
| 5 | SEE SHEET 2. C/N#4235 CLL 12-3-97 |

ORIGINAL

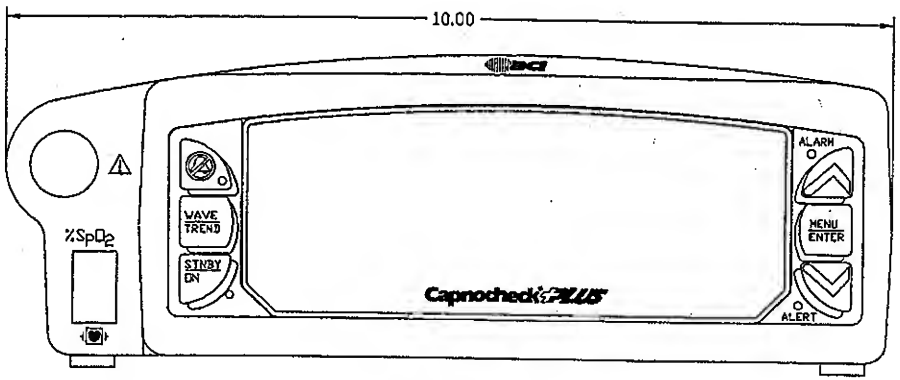


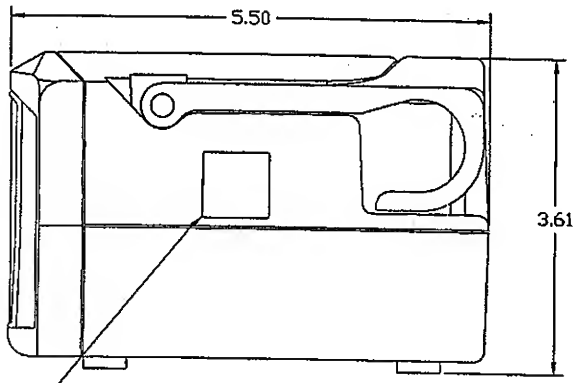

DETAIL D

BCI INTERNATIONAL

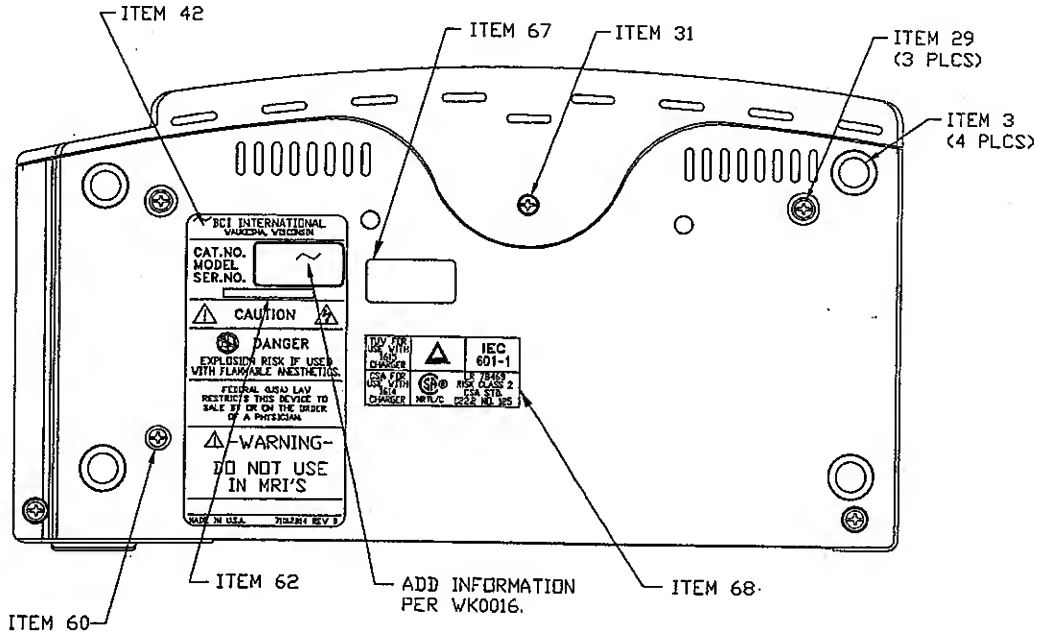
| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR. E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: J.M.PETER |
| THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT. | | DATE: 8-15-96 |
| | | MFG. APPR.: MS |
| MATERIAL: | | DATE: 8-16-96 |
| FINISH: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| TITLE: F/ASM NEWOX4 MONITOR (BEZEL, BOTTOM & PWB) | DRWG NO: 58500A1 | REV. 5 |
| | SHT. 5 OF 6 | |

A-18




ITEM 47




NOTE:

1) TO ATTACH COVER, ALIGN INSERT OPENINGS WITH INSERTS IN BOTTOM HALF AND SLIDE COVER DOWN.
2) MAKE SURE THE 4 PINS ALONG THE FRONT EDGE GO INTO THE HOLES IN THE TABS ON THE TOP EDGE OF THE BEZEL TO LOCK IT IN PLACE.
3) SECURE CASE TOGETHER USING ITEM 29 AS SHOWN IN THE BOTTOM VIEW OF THE CASE.

ORIGINAL

| DRWG NO: 58500A1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | REMVD IT'S 43-45 &49. REVISED IT. 42. ADDED IT. 60 & 62. IT. 29 WAS 4 PLCS. C/N'S 2740 & 2730 SDP/CLL 11-13-96 |
| 2 | SEE SHT'S 3, 4 & 5. C/N#2938 SDP 2-25-97 |
| 3 | ADDED ITEM 67. SEE SHEET 4. C/N#4045 MER 6-19-97 |
| 4 | ADDED ITEM 68. C/N#3097 MER 6-30-97 |
| 5 | SEE SHEET 2 C/N 4235 CLL 12-3-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: DWD | ENG. APPR. E.PALATNIK |
| DATE: 7-25-96 | DATE: 8-13-96 | DATE: 8-13-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR. J.M.PETER |
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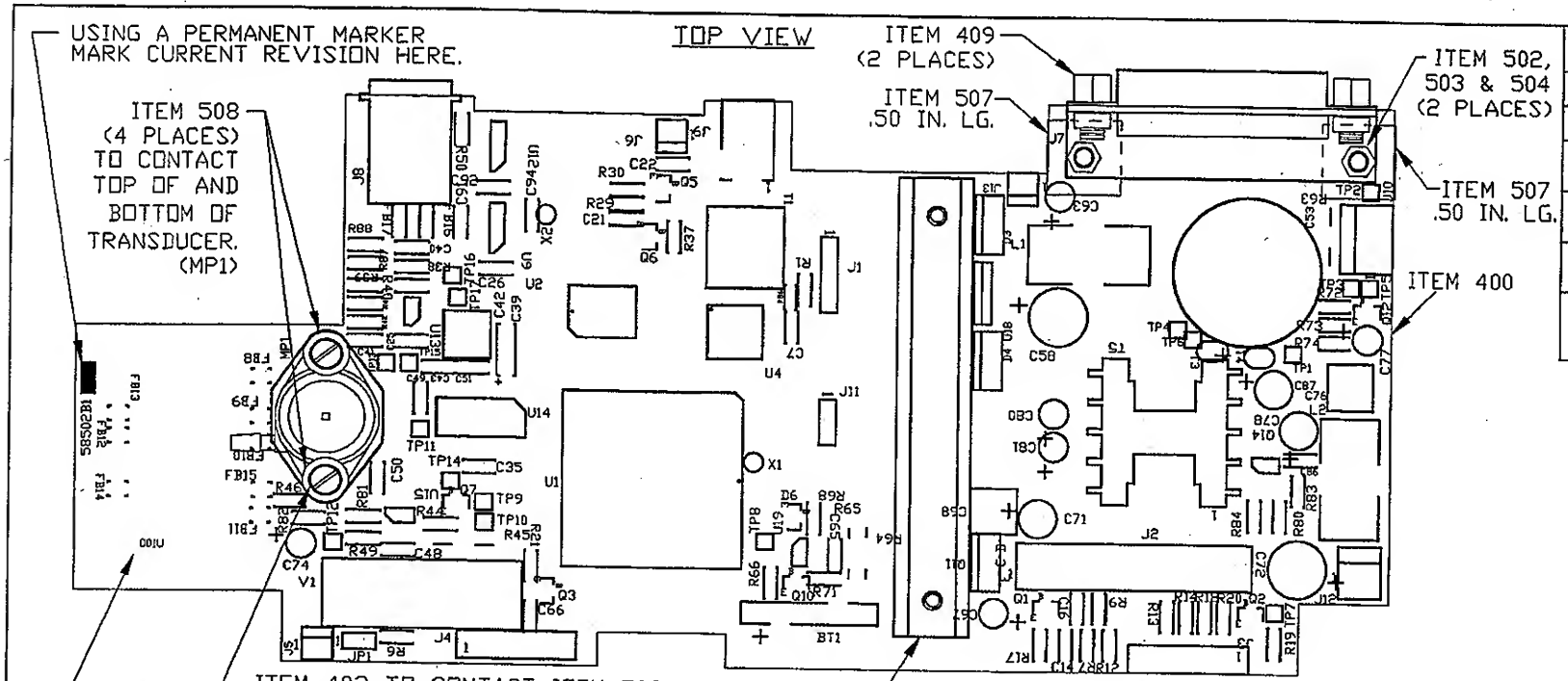
| | | MFG. APPR.: MS |
| | | DATE: 8-16-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1° |
| FINISH: | | |
| TITLE: F/ASM TRANSPORT CO2 MONITOR (CASE, FEET & LABELS) | DRWG NO: 58500A1 | REV. 5 |
| | SHT. 6 OF 6 | |

A-17




| DRWG NO: 58502B1 | |
|---|---|
| REV. | DESCRIPTION |
| 0 | PRODUCTION RELEASE, C/N# 2921 CLL 1-21-97 |
| 1 | TP-17 WAS U13-3, ADDED JUMPER ON U13, & 2 RES. C/N# 2983 SDP 2-25-97 |
| 2 | ADDED ITEM 507, KAPTON TAPE, SEE SHEET 2 C/N# 4007 CLL 5-13-97 |
| 3 | REVISED TO REFLECT REV. E BOARD LAYOUT C/N 4040 KMK 6-5-97 |
| 4 | ADDED ITEM 508. REVISED ITEMS 402 & 403. SEE HISTORY FOR PREV. REVS. C/N 4293 MER 12-22-97 |

ORIGINAL

SHEET 3-6 "V" SIZE (BOM)

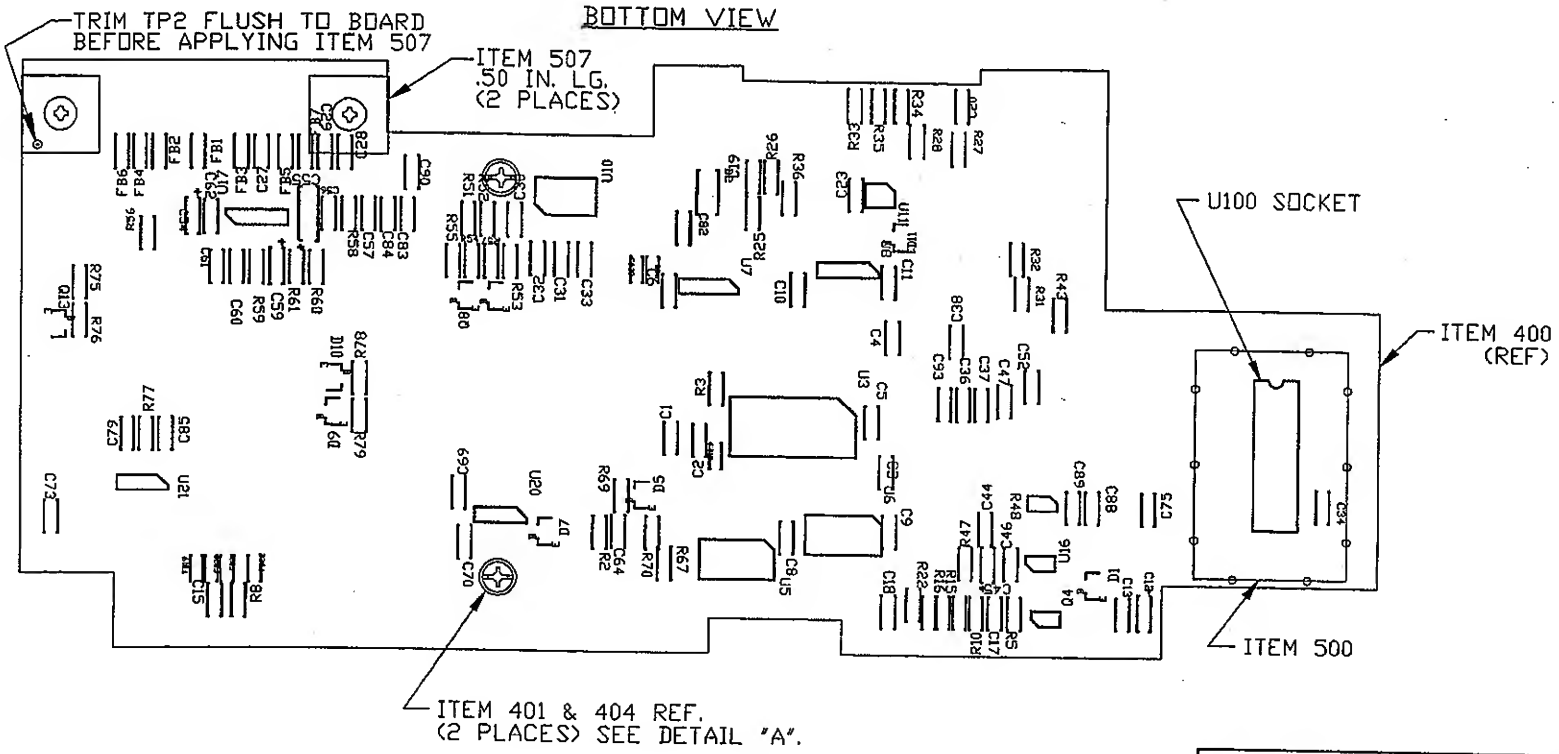
NOTE:

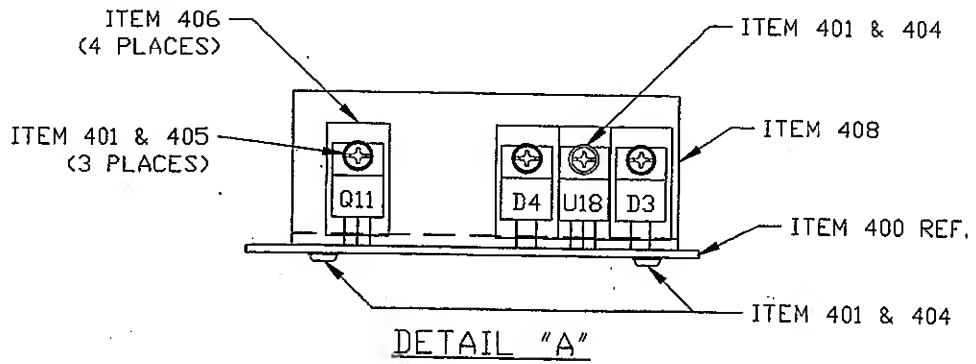
1) MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON BOARD.
2) IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3) VENDOR IS TO BUY, PROGRAM AND INSTALL E-PROM PER SOFTWARE ASSEMBLY ITEM 501.
4) HOT GLUE L1, L2, C58, C72, C78 C80, C81 & C87 USING ITEM 505.
5) SECURE X1 & X2 USING RTV, ITEM 506.

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: RJR | ENG. APPR.: E.Palatnik |
| DATE: 10-27-95 | DATE: 1-22-97 | DATE: 1-21-97 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: J.M.Peter |
| THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT. | | DATE: 1-22-97 |
| | | MFG. APPR.: M.S. |
| MATERIAL: | | DATE: 1-22-97 |
| FINISH: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1° |
| TITLE: PWB ASM MAIN BOARD - CO2 TRANSPORT | DRWG NO: 58502B1 | REV. 4 |
| | SHT. 1 OF 6 | |

A-18




DETAIL "A"

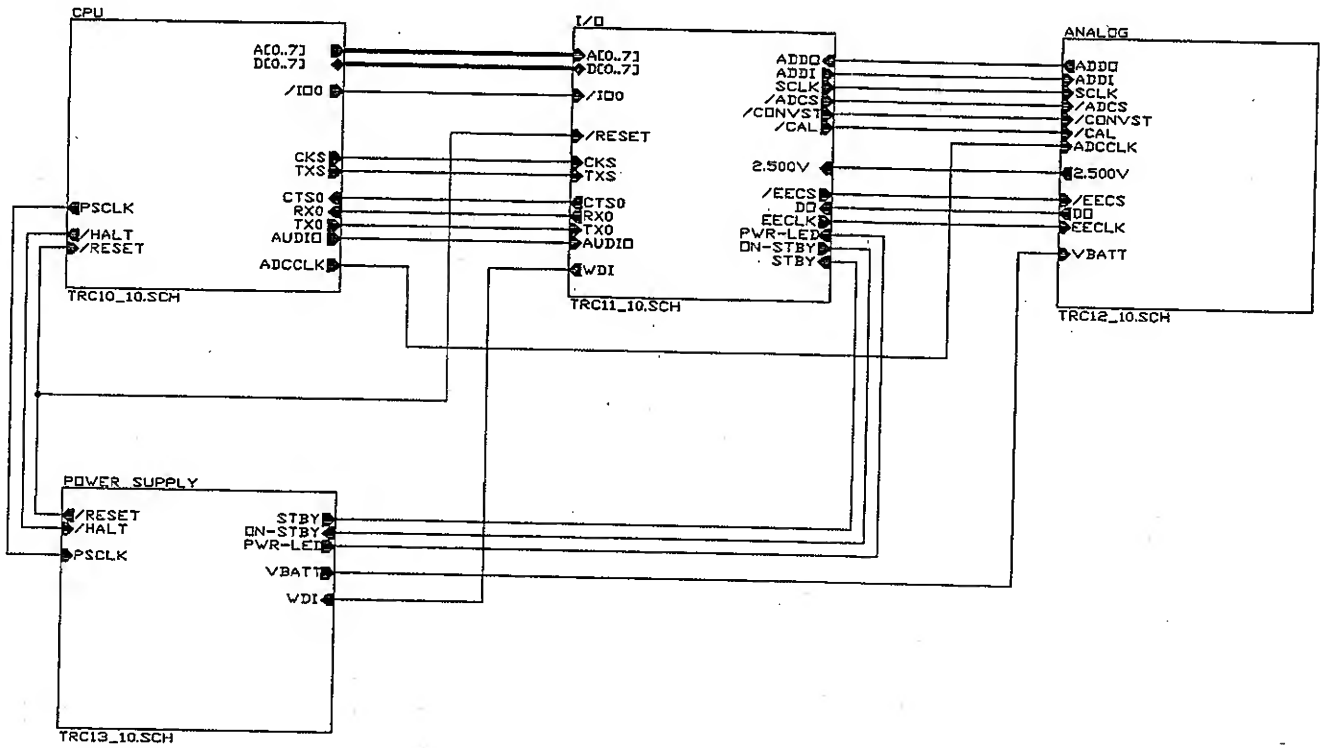
| DRWG NO: 58502B1 | |
|---|---|
| REV. | DESCRIPTION |
| 0 | SEE SHEET 1<br>C/N# 2921 CLL 1-21-97 |
| 1 | REM'VD R31, 32, & C24.<br>C/N# 2983 SDP 2-25-97 |
| 2 | ADDED ITEM 507, KAPTON TAPE, SEE SHEET 1<br>C/N# 4007 CLL 5-13-97 |
| 3 | REVISED TO REFLECT REV. E BOARD LAYOUT<br>C/N 4040 KMK 6-5-97 |
| 4 | SEE SHEET 1<br>C/N# 4293 MER 12-22-97 |

ORIGINAL

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: RJR | ENG. APPR.: E.Palatnik |
| DATE: 10-27-95 | DATE: 1-22-97 | DATE: 1-21-97 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: J.M.Peter |
| THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT. | | DATE: 1-22-97 |
| | | MFG. APPR.: M.S. |
| MATERIAL: | | DATE: 1-22-97 |
| FINISH: | | TOLERANCE UNLESS OTHERWISE SPECIFIED:<br>XX: ± .010<br>XXX: ± .005<br>ANGLES: ± 1° |
| TITLE: PWB ASM MAIN BOARD - CO2 TRANSPORT | | DRWG NO: 58502B1 REV. 4<br>SHT. 2 OF 6 |

A-19




| DRWG NO: 58502S1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHEET 4, C/N 4040 KMK 6-5-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: NLL | CHK. BY: KMKinsey | ENG. APPR.: E.Palatnik |
| DATE: 10-10-96 | DATE: 10-10-96 | DATE: 10-10-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: JMPeter |
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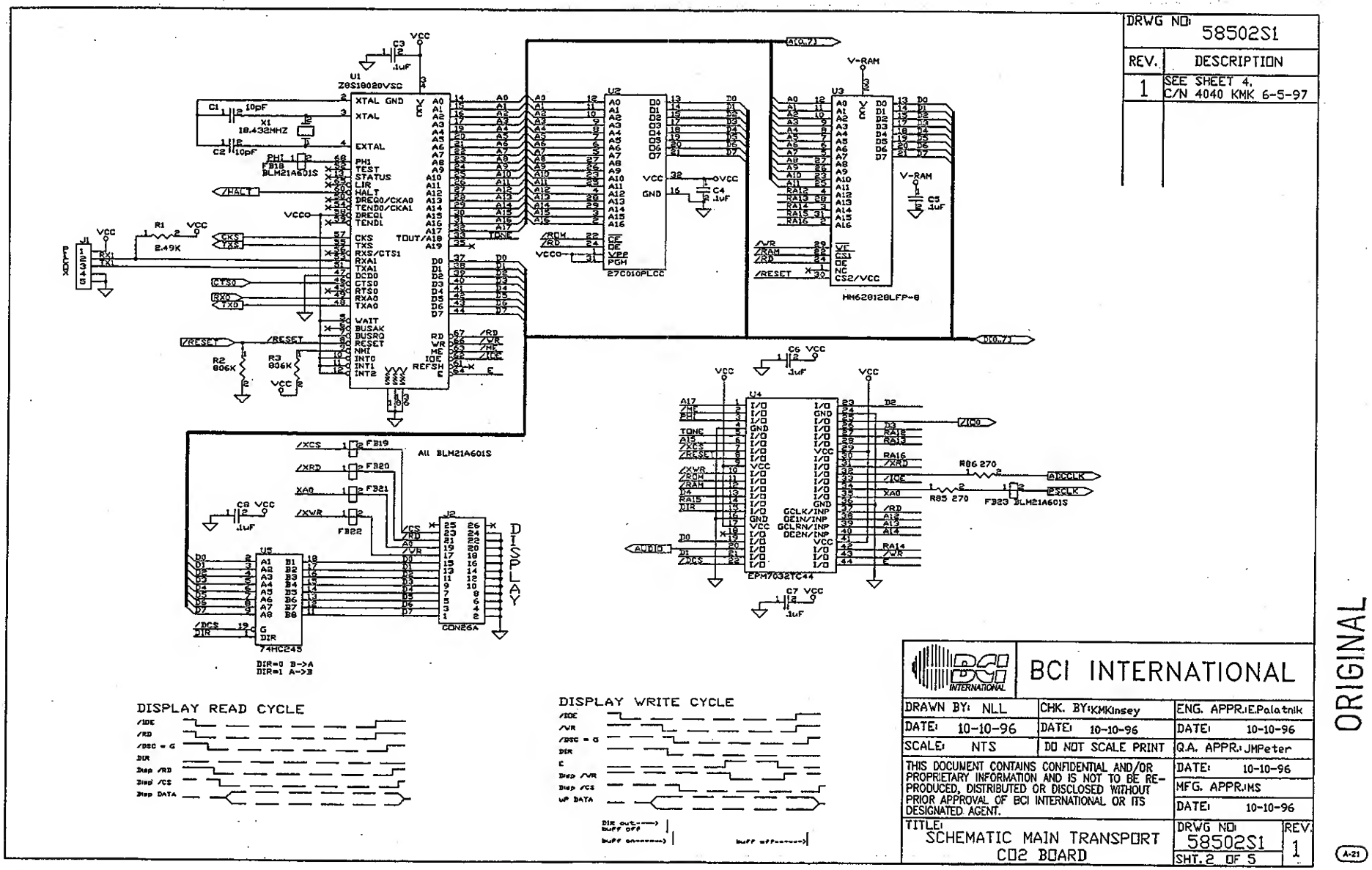
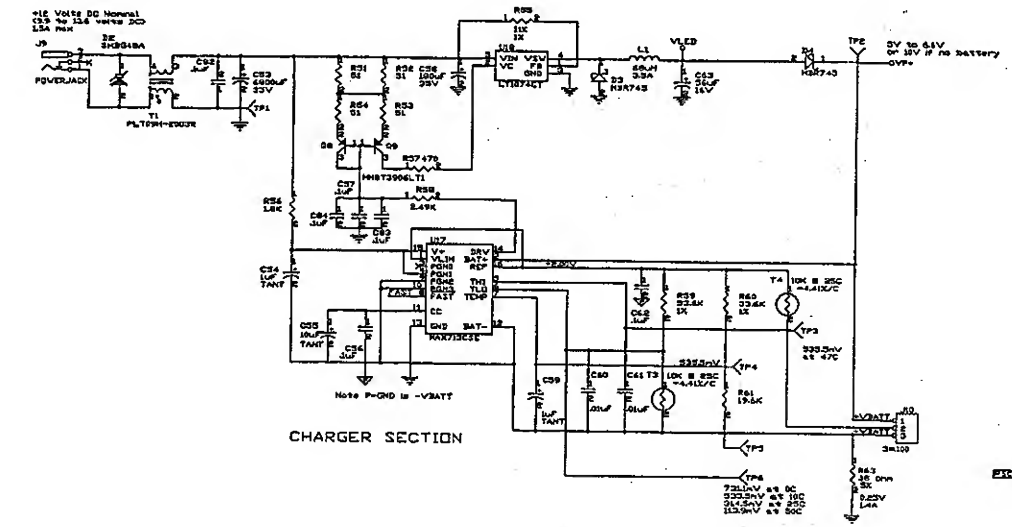
| | | MFG. APPR.: MS |
| | | DATE: 10-10-96 |

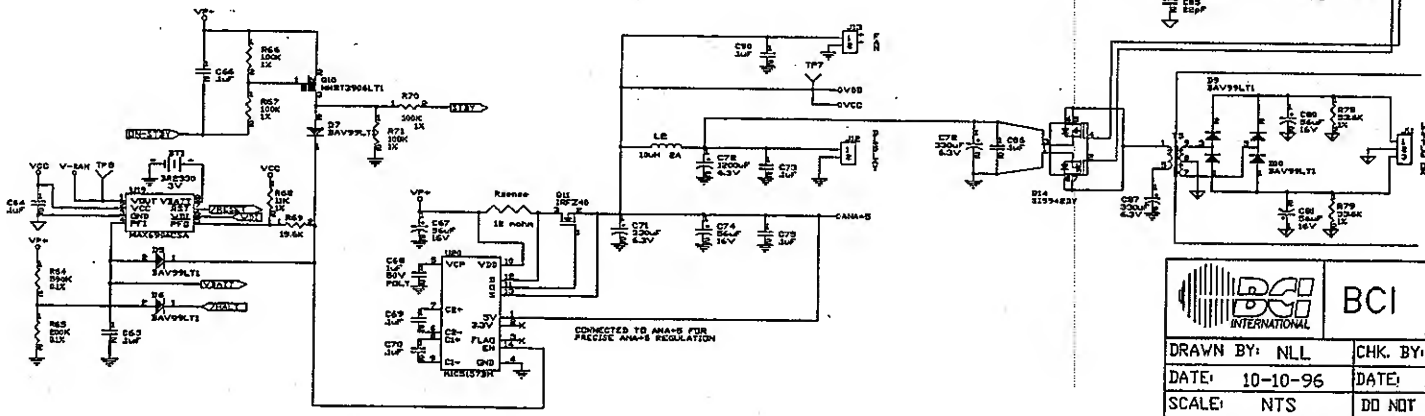
| TITLE: SCHEMATIC MAIN TRANSPORT CO2 BOARD | DRWG NO: 58502S1 | REV. 1 |
|---|---|---|
| | SHT. 1 OF 5 | |

ORIGINAL

A-20


DRWG NO: 58502S1
REV. DESCRIPTION
1 SEE SHEET 4, C/N 4040 KMK 6-5-97
U1 Z0S18020VSC
XTAL GND
XTAL
EXTAL
PH1
TEST
STATUS
LIR
HALT
DREQ0/CKA0
TEND0/CKA1
DREQ1
TEND1
CKS
TXS
RXS/CTS1
RXA1
TXA1
DCD0
CTS0
RTS0
RXA0
TXA0
WAIT
BUSAK
BUSRQ
RESET
NMI
INT0
INT1
INT2
TOUT/A18
A19
RD
WR
ME
IOE
REFSH
U2 27C010PLCC
U3 HM628128LFP-8
V-RAM
U4 EPM7032TC44
U5 74HC245
CON26A
DISPLAY
All BLM21A601S
DIR=0 B->A
DIR=1 A->B
DISPLAY READ CYCLE
DISPLAY WRITE CYCLE
BCI INTERNATIONAL
DRAWN BY: NLL
CHK. BY: KMKinsey
ENG. APPR.: E.Palatnik
DATE: 10-10-96
SCALE: NTS
DO NOT SCALE PRINT
Q.A. APPR.: JMPeter
MFG. APPR.: MS
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE REPRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.
TITLE: SCHEMATIC MAIN TRANSPORT C02 BOARD
DRWG NO: 58502S1
REV: 1
SHT. 2 OF 5
ORIGINAL
A-21



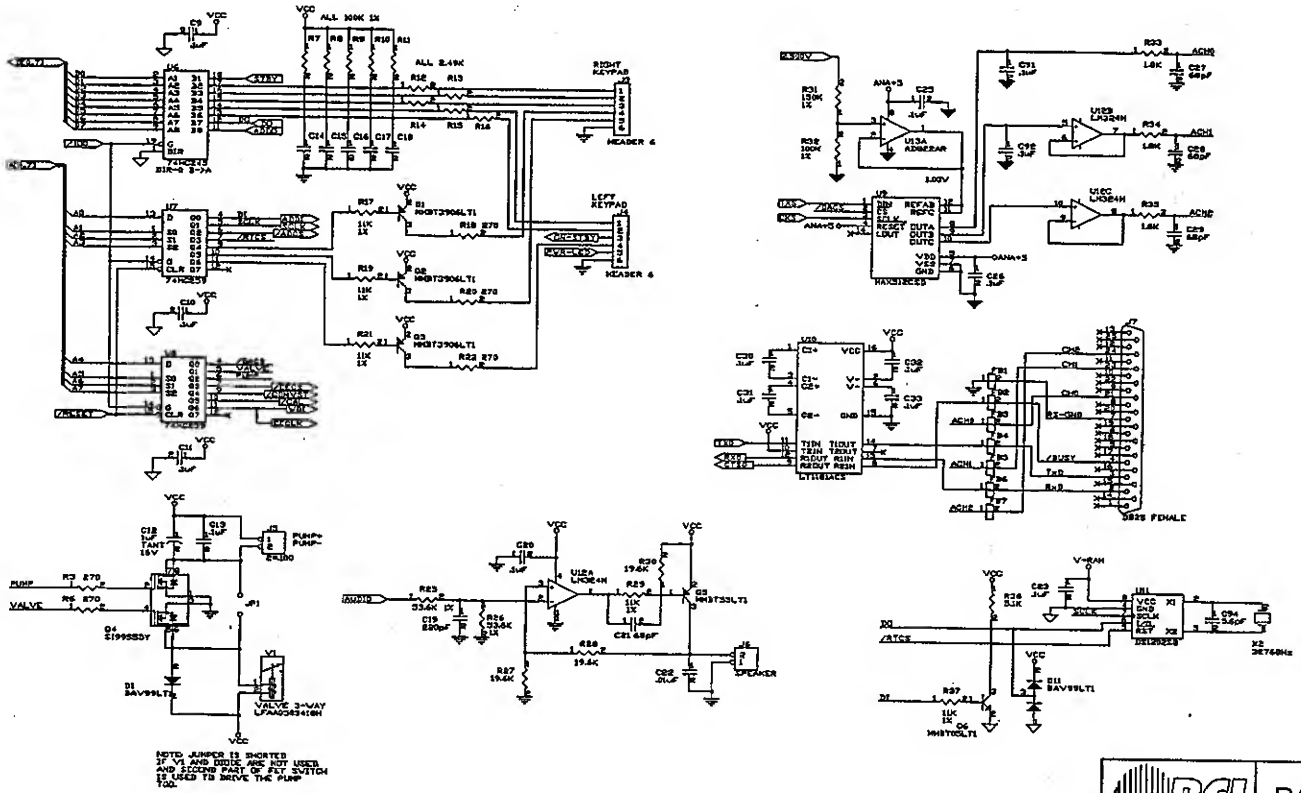

| DRWG NO: 58502S1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHEET 4. C/N 4040 KMK 6-5-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: NLL | CHK. BY: KMKinsey | ENG. APPR.: E.Palatnik |
| DATE: 10-10-96 | DATE: 10-10-96 | DATE: 10-10-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: JMPeter |
| THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT. | | DATE: 10-10-96 |
| | | MFG. APPR.: MS |
| | | DATE: 10-10-96 |
| TITLE: SCHEMATIC MAIN TRANSPORT C02 BOARD | | DRWG NO: 58502S1 REV: 1 |
| | | SHT. 3 OF 5 |

ORIGINAL

A-22

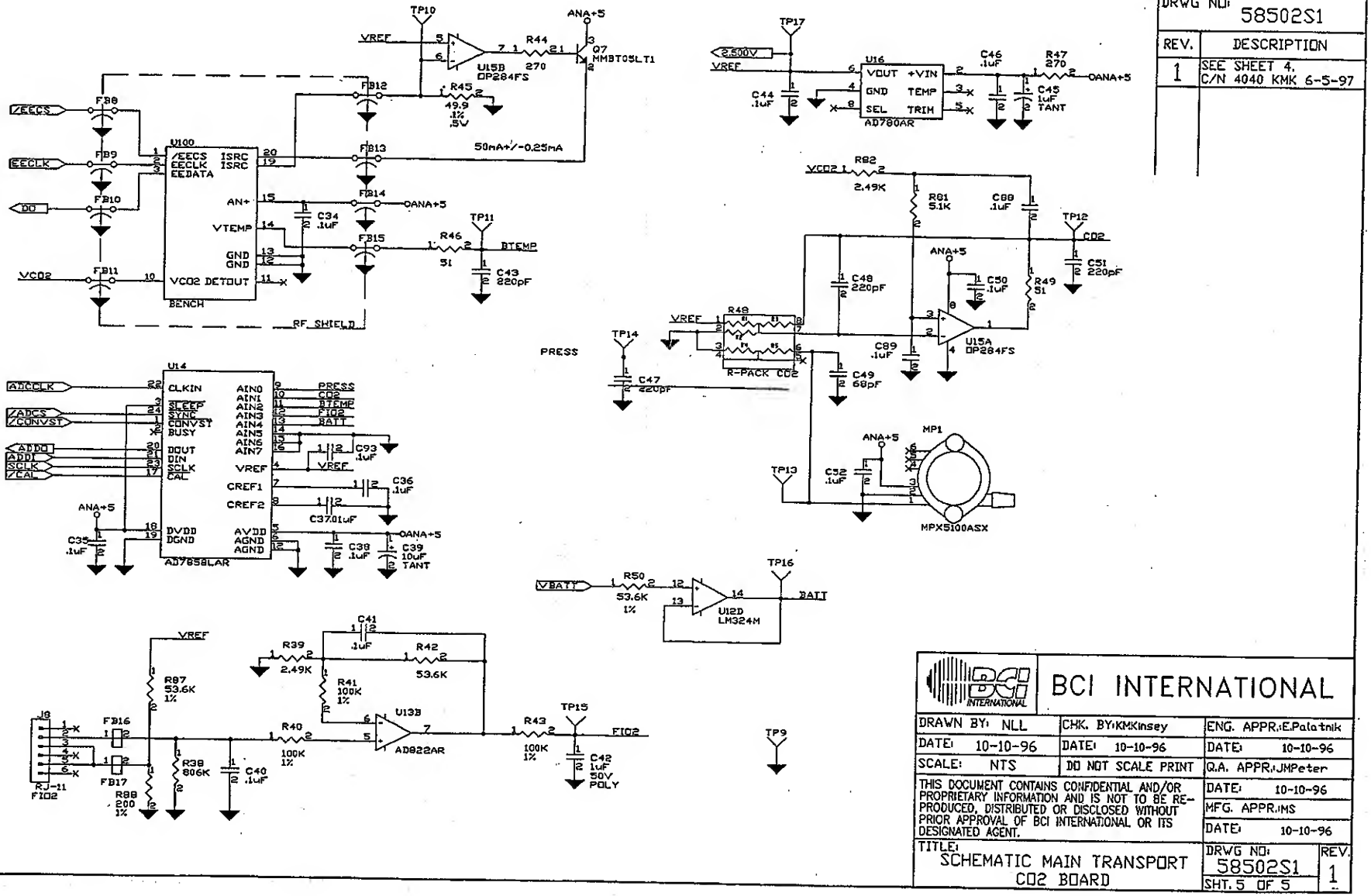


| DRWG NO: 58502S1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | R31 WAS 464K.<br>R32 WAS 11K.<br>C/N 4040 KMK 6-5-97 |
| | |
| | |

| BCI INTERNATIONAL | | |
|---|---|---|
| DRAWN BY: NLL | CHK. BY: KMKinsey | ENG. APPR.: E.Palatnik |
| DATE: 10-10-96 | DATE: 10-10-96 | DATE: 10-10-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: JMPeter |
| THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT. | | DATE: 10-10-96 |
| | | MFG. APPR.: MS |
| | | DATE: 10-10-96 |
| TITLE: SCHEMATIC MAIN TRANSPORT CO2 BOARD | | DRWG NO: 58502S1 REV. 1 |
| | | SHT. 4 OF 5 |

ORIGINAL

A-23




| DRWG NO: 58502S1 | |
|---|---|
| REV. | DESCRIPTION |
| 1 | SEE SHEET 4. C/N 4040 KMK 6-5-97 |

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: NLL | CHK. BY: KMKinsey | ENG. APPR.: E.Palatnik |
| DATE: 10-10-96 | DATE: 10-10-96 | DATE: 10-10-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: JMPeter |
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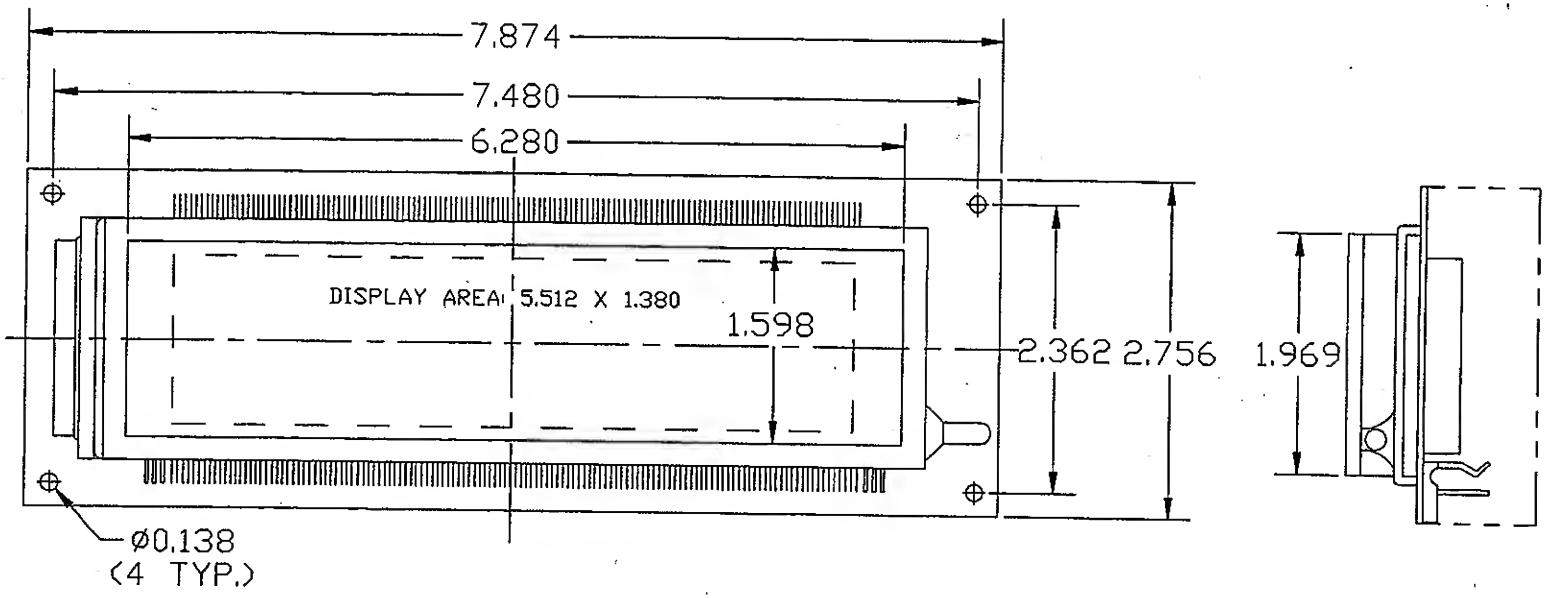
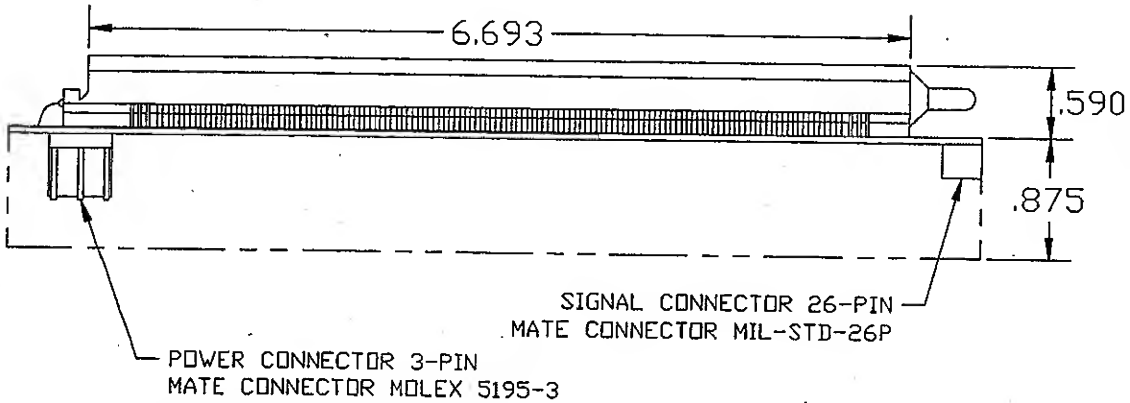
| | | MFG. APPR.: MS |
| | | DATE: 10-10-96 |
| TITLE: SCHEMATIC MAIN TRANSPORT CO2 BOARD | | DRWG NO: 58502S1 REV. 1 |
| | | SHT. 5 OF 5 |

ORIGINAL

| DRWG NO: 58520B1 | |
|---|---|
| REV. | DESCRIPTION |
| | |




APPROVED MANUFACTURER:
ISE ELECTRONICS CORP. GU256X64-332A

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: BAE | CHK. BY: | ENG. APPR. |
| DATE: 11/27/95 | DATE: 11-28-95 | DATE: 11/28/95 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR. |
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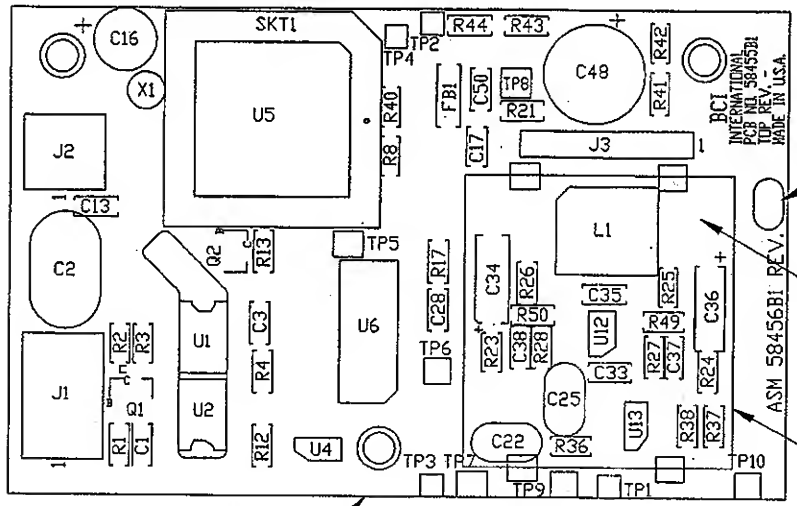
| | | MFG. APPR. |
| | | DATE: 11-28-95 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.020 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: DISPLAY VACUUM FLUORESCENT GRAPHIC | | DRWG NO: 58520B1 REV: 0 |
| | | SHT. 1 OF 1 |

A-25

ORIGINAL

## TOP VIEW




ITEM 400

USING A PERMANENT MARKER MARK HERE WITH CURRENT REVISION.

ITEM 403 PASTED INSIDE THE TOP OF ITEM 402.

ITEM 402

| DRWG NO: 58456B1 | |
|---|---|
| REV. | DESCRIPTION |
| B | REMOVED C46 & C47 FROM SILKSCREEN, MOVED TP10 & R17, ADDED R49, R50, FAB & ASM NOTES .15" TO PWB LENGTH, "J3" WAS 103321-7 AMP. RJR 12-18-95 |
| C | PG3 .1uF 50V 20% WAS 10%, 0805 Z5U SMT WAS X7R, MMBTA05LT1 WAS MMBT05LT1, AND 2.15K 1% WAS 5%. RJR 12-20-95 |
| D | ON SHT 3 - C28 WAS 0805 & C48 WAS ECA-1AFQ4715. RJR 01-17-96 |
| E | REVISED NOTE 3, SHT3 C28 WAS 1206, ADDED MOTOROLA AND INT'L REC. TO Q1-6. RJR 01-18-96 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |
| 1 | ADDED ALT. PART TO D1, D2 Q3, & U7. C/N 2440 SDP 4/22/96 |
| 2 | ADDED ALT. PARTS TO Q4 & Q5. FAR 1570 SDP 5/17/96 |
| 3 | ADDED ITEM'S 402, 403 & SOCKET 1. C/N #2611 SDP 6/13/96 |
| 4 | J1 WAS 22-14-2054 J2 WAS 22-14-2034 C/N #2901 CLL 1/31/97 |
| 5 | J1 WAS 22-17-2062 J2 WAS 22-17-2042 C/N #3049 KMK 4-11-97 |
| 6 | SEE SHEET 2. C/N #4059 MER 6-19-97 |
| 7 | ECU-V1H102JCX WAS ECU-V1H102JCH. SHEET 3. C/N #4072 MER 6-27-97 |

SHEET 3-4 "V" SIZE (BOM)

NOTE:

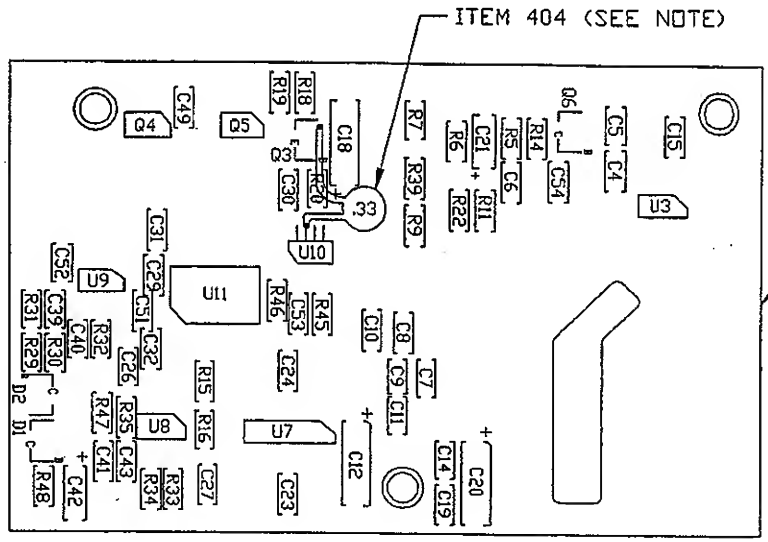
1) MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON BOARD.
2) IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3) VENDOR IS TO BUY, PROGRAM AND INSTALL uCONTROLLER (U5) PER SOFTWARE ASSEMBLY ITEM 401.

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: SCS | ENG. APPR.: M.S.Geisler |
| DATE: 11-24-95 | DATE: 1-18-96 | DATE: 1-19-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: D.Siefert |
|  | | DATE: 1-19-96 |
| | | MFG. APPR.: Ann M. Johnson |
| | | DATE: 1-19-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: PWB ASM OXIMETER BOARD - NIBP/CO2 TRANS. | DRWG NO: 58456B1 | REV. 7 |
| | SHT. 1 OF 4 | |

A-26

ORIGINAL




BOTTOM VIEW

NOTE: SOLDER LEADS BETWEEN PIN 7-U10, & Q3, R18, R19, U10 PIN 6 NODE.

DRWG NO: 58456B1

| REV. | DESCRIPTION |
|---|---|
| B | COMPONENT LAYOUT WAS REVISED, ADDED C53, C54, R45, R46, R47, R48, D1, D2 AND Q6. RJR 12-18-95 |
| C | SEE SHEET 1 FOR CHANGES. RJR 12-20-95 |
| D | CORRECTED R53 TO R35. RJR 01-17-96 |
| E | NO CHANGE THIS PAGE. RJR 01-18-96 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |
| 1 | ADDED ALT. PART TO D1, D2, Q3, & U7. C/N 2440 SDP 4/22/96 |
| 2 | SEE SHEET 1. EAR 1570 SDP 5/17/96 |
| 3 | SEE SHEET 1. C/N #2611 SDP 6/13/96 |
| 4 | SEE SHEET 1. C/N #2901 CLL 1/31/97 |
| 5 | SEE SHEET 1. C/N 3049 KMK 4-11-97 |
| 6 | ADDED ITEM 404 & NOTE. C/N 4059 MER 6-19-97 |
| 7 | SEE SHEET 1. C/N 4072 MER 6-27-97 |

ORIGINAL

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: SCS | ENG. APPR.: M.S.Geisler |
| DATE: 11-24-95 | DATE: 1-18-96 | DATE: 1-19-96 |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR.: D.Siefert |
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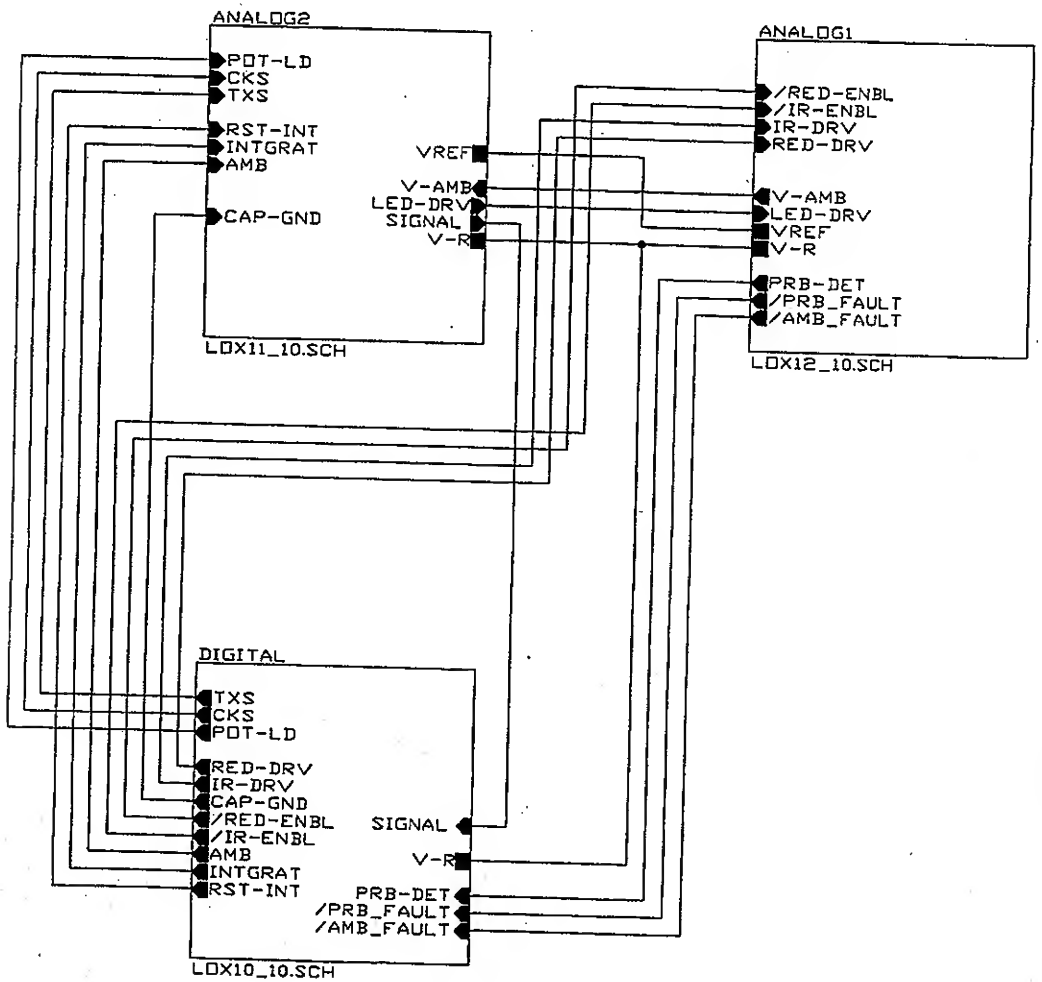
| | | MFG. APPR.: Ann M. Johnson |
| | | DATE: 1-19-96 |
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: PWB ASM OXIMETER BOARD - NIBP/CO2 TRANS. | | DRWG NO: 58456B1 REV: 7 |
| | | SHT. 2 OF 4 |




| DRWG NO: 58456S1 | |
|---|---|
| REV. | DESCRIPTION |
| B | NO CHANGE THIS PAGE. RJR 12-18-95 |
| C | NO CHANGE THIS PAGE. RJR 12-20-95 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |
| | |

ORIGINAL

BCI INTERNATIONAL

| | | |
|---|---|---|
| DRAWN BY: RJR | CHK. BY: SC2 | ENG. APPR.: 1-19-96 |
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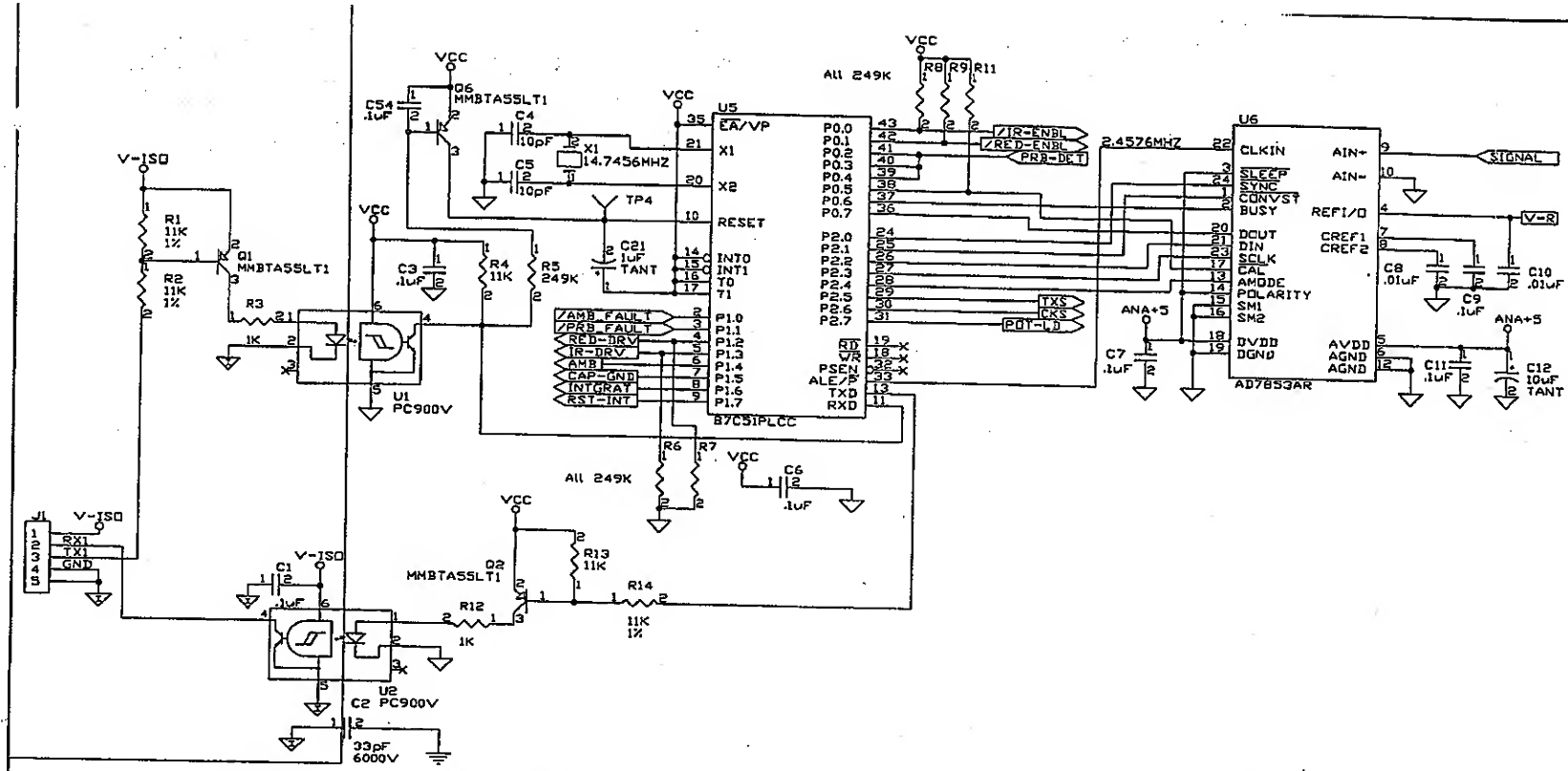
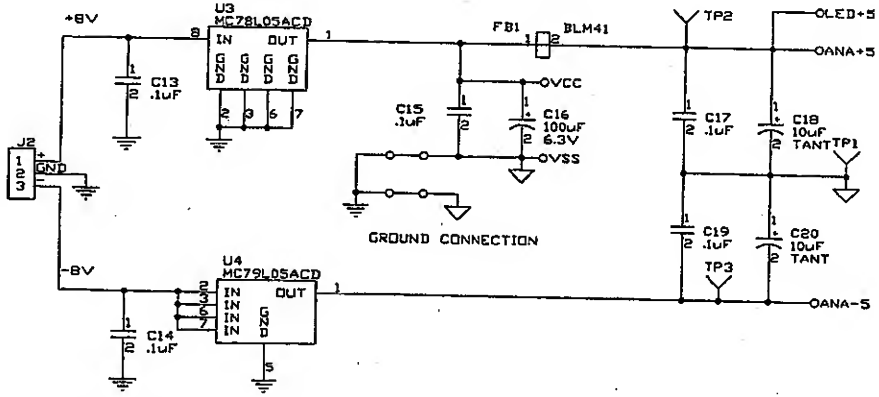
| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: SCHEMATIC OXIMETER BOARD NIBP | DRWG NO: 58456S1 | REV. 0 |
| | SHT. 1 OF 4 | |

A-20




| DRWG NO: 58456S1 | |
|---|---|
| REV. | DESCRIPTION |
| B | ADDED C54 AND Q6 FROM U5 PIN 10 TO R5 PIN1. RJR 12-18-95 |
| C | NO CHANGE THIS PAGE. RJR 12-20-95 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |
| | |

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| | | MFG. APPR: Ronald M. Johnson |
| MATERIAL: | | DATE: 1/19/96 |
| FINISH: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| TITLE: SCHEMATIC OXIMETER BOARD NIBP | | DRWG NO: 58456S1 REV: 0 |
| | | SHT. 2 OF 4 |

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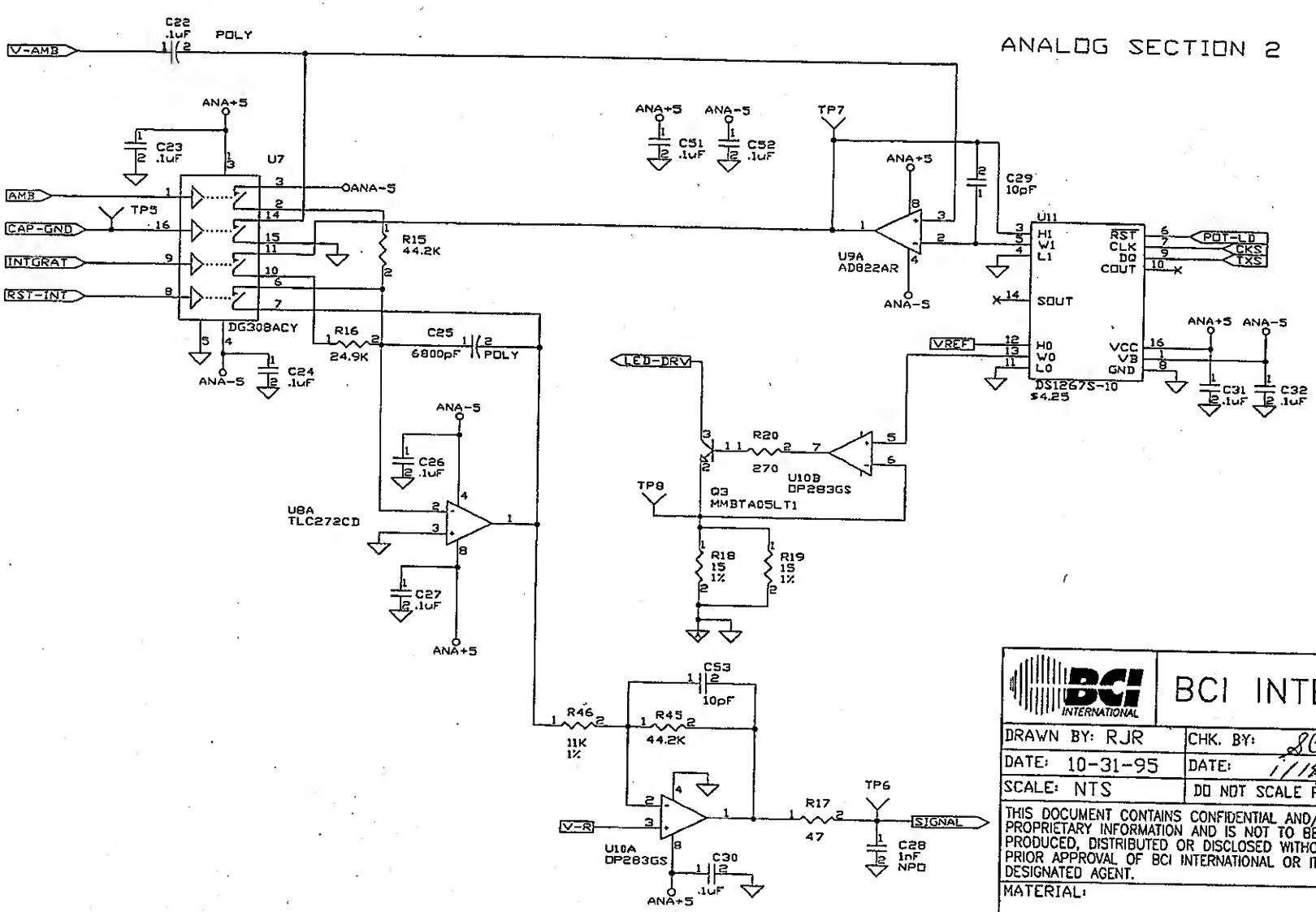
# ANALOG SECTION 2




| DRWG NO: 58456S1 | |
|---|---|
| REV. | DESCRIPTION |
| B | "U9A" WAS OP283GS. RJR 12-18-95 |
| C | "Q3" MMBTA05LT1 WAS MMBT05LT1. RJR 12-20-95 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |

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|---|---|---|
| DRAWN BY: RJR | CHK. BY: SCS | ENG. APPR. DATE: 1-19-96 |
| DATE: 10-31-95 | DATE: 1/18/96 | DATE: |
| SCALE: NTS | DO NOT SCALE PRINT | Q.A. APPR. DATE: 1-19-96 |
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| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: SCHEMATIC OXIMETER BOARD NIBP | | DRWG NO: 58456S1 REV. 0 SHT. 3 OF 4 |

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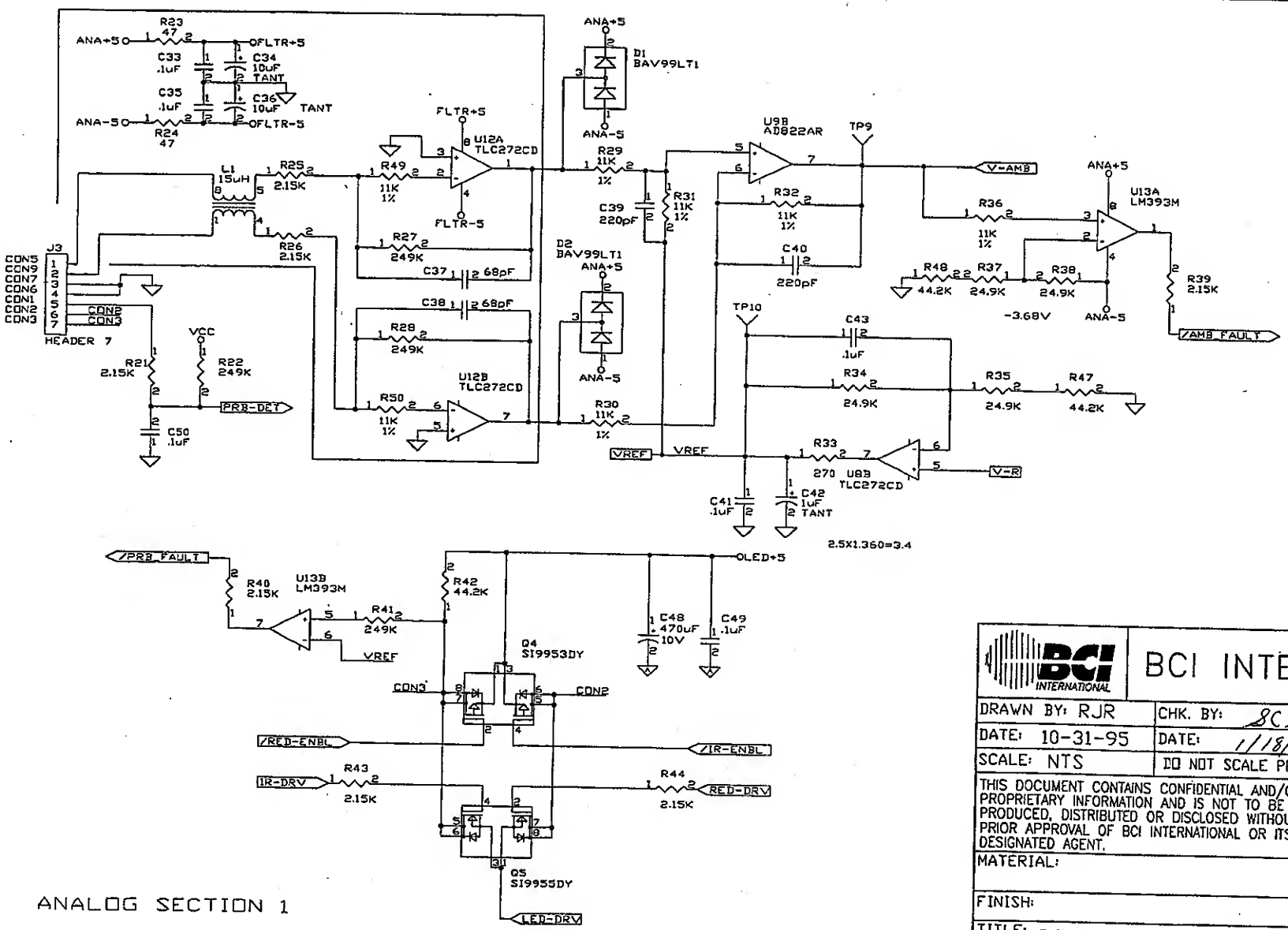


ANALOG SECTION 1

| DRWG NO: 58456S1 | |
|---|---|
| REV. | DESCRIPTION |
| B | 'U9A' WAS OP283GS AND 'R42' WAS 249K. RJR 12-18-95 |
| C | NO CHANGE THIS PAGE. RJR 12-20-95 |
| 0 | PRODUCTION RELEASE. RJR 01-18-96 |

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| DRAWN BY: RJR | CHK. BY: SC B | ENG. APPR.: DATE: 1-19-96 |
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| MATERIAL: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1° |
| FINISH: | | |
| TITLE: SCHEMATIC OXIMETER BOARD NIBP | DRWG NO: 58456S1 | REV. 0 |
| | SHT. 4 OF 4 | |

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